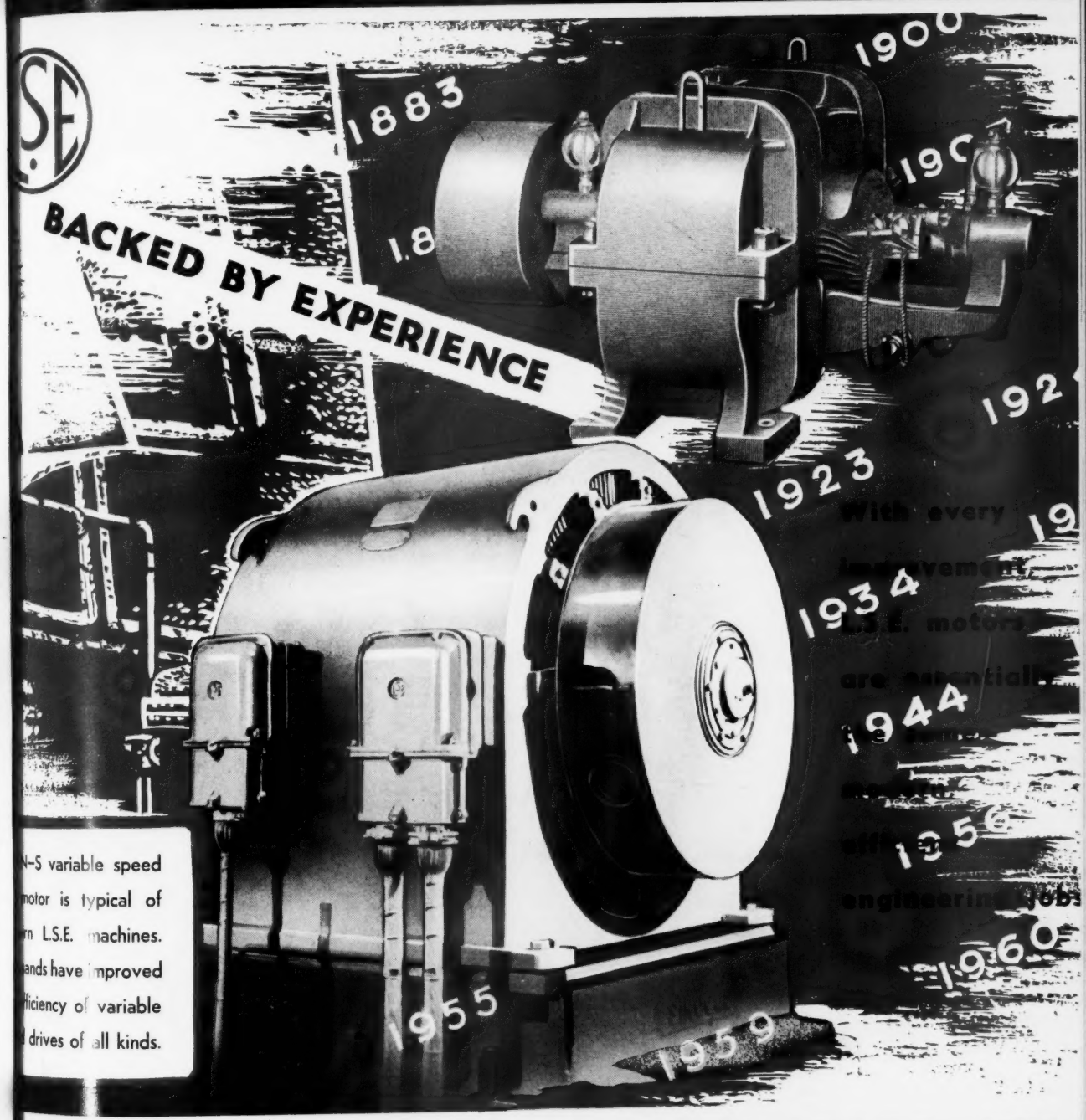
ELECTRICAL REVIEW



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ELECTRICAL REVIEW

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10 FEBRUARY 1956

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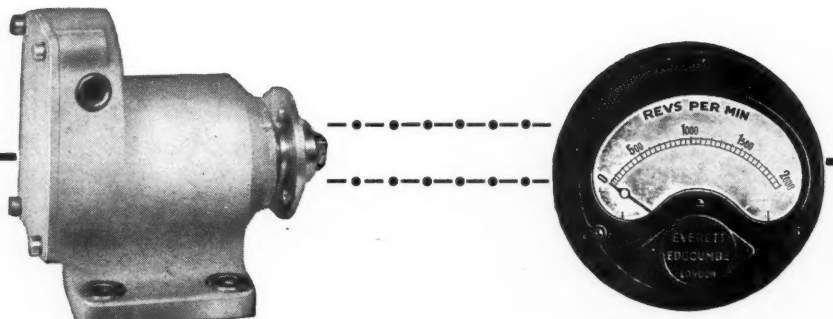
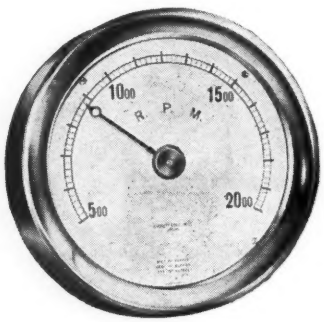
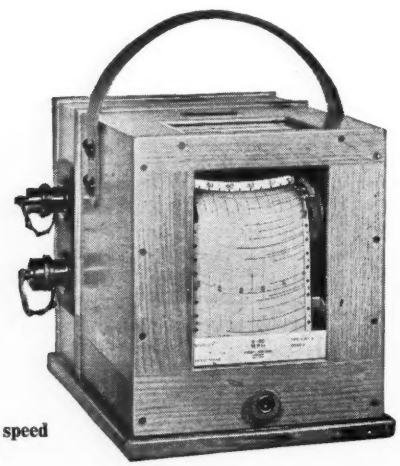
Electric Speedmeters



Typical speed transmitter for floor or bracket mounting.



Disc scale indicating speedmeter.



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ELECTRICAL REVIEW

10 February 1956 Vol. 158 No. 6 Established 1872

Good—But Could It Be Better?

ALL of us who have closely watched the integration of the electricity supply industry for the past eight years will agree with the Herbert Committee (whose report is reviewed in this issue) that the Central Authority and Area Boards have done extremely well. The Committee says that it would be quite wrong to call the industry inefficient or its organization a bad one. It has caught up with the post-war plant shortage and managed to keep the price of electricity down to an average of only 30 per cent above the 1939 level. Nevertheless the Committee thinks that there are shortcomings which should be remedied; it mentions *inter alia* that it has discovered excessive centralization and a denial of responsibility to the smaller units, which, it considers, slow up the machine. Too much responsibility resides in the Board chairmen some of whom are in effect " managing " their areas—a task which should be left to their senior executive officers. The Committee considers that attention must be paid to these points and to the question of remuneration if the industry is to attract and retain an adequate supply of first-rate technical and managerial talent.

The existing segregation of generation and main transmission from distribution and sales is accepted by the Committee, in which matter it is in line with our own convictions. But it is recommended that a new " Central Electricity Generation Board " should be established to take over the power stations and grid from the Central Electricity Authority. The C.E.A. would then, as its main duty, " keep the industry on its toes " and have much more say in the policy and activities of the Area Boards. It is somewhat contradictory that this should be proposed when at the same time greater autonomy is advocated for the Area Boards and the proposed new Generation Board even to the extent of raising their own capital.

It is pleasing to us to see that the Committee shares the view put forward in our leading article of 20th January that too much Parliamentary interference is bound to result in bureaucracy and rigidity. It recommends greater use of commercial methods and modern aids to good management but seems to ignore what has already been done in this direction.

In dealing with accounts the Committee shows itself to be against the present " historical cost " basis of depreciation and in favour of replacement-cost allowances and it recommends the securing of a higher margin of revenue over expenditure. This, and other of the Committee's proposals seem to be ominous for the consumer. The Committee says though, that in securing the higher margin the Boards should not look to increases of tariffs until they have made a much more vigorous attack on costs in terms of capital and manpower. Also it is not in favour of financing capital developments from revenue. The consumer may hope, therefore, that his electricity will not cost him much more if the Committee's recommendations are acted upon by the Government. We are a little anxious about the possible effects of the adoption of all the Committee's proposals. It is one thing to urge a not-inefficient existing organization to do better and another to start all over again and perhaps arrive at the same place.

Production difficulties caused by the dispute in the printing industry still continue and we again ask our readers' indulgence for certain deficiencies which may be noticed in this week's *Electrical Review*.

PRINTING PRESS DRIVES

During the last 50 years or so there have been few changes in the basic design of rotary printing presses but many refinements and improvements have been introduced to improve the quality of the product, the rate of output and convenience of operation. As Mr. F. W. Ralph points out in this issue, these improvements emphasize the importance of a special approach to the design of printing press drives. In his article, Mr. Ralph briefly reviews the development of all the various kinds of electrical equipment which have been used to drive rotary printing presses. He then deals with currently used types in some detail; d.c. motors fed by grid-controlled mercury arc rectifiers, a.c. commutator motors of various types, and electronic and magnetic amplifier control schemes. The electronic control system offers great flexibility and ease of operation but the use of electronics for controlling drives is by no means the only application of this type of equipment in the printing industry. Typical examples which may be mentioned are the automatic splicing of the web from one reel of newsprint to that of another at full printing speed, the detection of a web breakage during an edition and the initiation of the stopping and braking of a press.

DISTRICT HEATING

The further particulars of the Pimlico district heating scheme given by Messrs. Donkin, Johnston & Ockenden in the paper summarized in this issue indicate the dependence of the success of such a project on inexpensive facilities for heat distribution coupled with local heat storage. As the authors pointed out, the scheme cannot be regarded as a typical example from which general conclusions can be drawn. Its proximity to a large generating station, to which the local heat substation is connected by mains running through an existing tunnel under the River Thames instead of under streets, is a specially favourable feature. The provision of an almost ready-made concentrated load is another factor that enables hot water to be supplied to tenants at an acceptable price. On the other hand there are no adjacent industries requiring exhaust steam for process which might have helped its finances.

STREET LIGHTING DEFICIENCIES

There has been much talk for many years now about street lighting requirements and the design of fittings and equipment to suit particular towns and stretches of road. Undoubtedly efforts have been made throughout the country during the last year or so to improve the standard of public lighting, but if one undertakes a long car journey by night it soon becomes obvious that a great deal remains to be done. From the motorist's point of view the lack of uniformity in the type of lighting from town to town and even within individual towns, combined with a general tendency to glare, is the most worrying feature of public lighting and in fact most motorists would prefer no street lighting at all to what they have to drive through in some places. Insufficient attention seems to be paid to the avoidance of black spots when lighting installations are designed. These cause pedestrians to become invisible to the motorist, which is highly dangerous. Furthermore, it would appear that a wider use of the cut-off type lantern for main road lighting would contribute greatly to the safety of pedestrians and the peace of mind of motorists.

UNIVERSITY TRAINING FOR TECHNOLOGISTS

In a paper in a symposium entitled "Sandwich Courses" presented recently to the Institution of Mechanical Engineers, Mr. R. McCrae, B.Sc. (Eng.), refers to the Minister of Education's statement to Parliament before the last summer vacation that the route through the universities was far too narrow to provide the large number of technologists required by industry if industrial expansion was to be maintained at the rate necessary for Britain's economic survival. He also indicated that an expansion of the sandwich courses of the type in which the students spend six months at a technical college in full-time study and six months in industry in each year of the course offered a most promising solution of the difficulty. The periods of six months' full-time study make it possible to give a much broader academic training than can be provided in a part-time course. Further, the six months' full-time training in industry gives students a more intimate understanding of industrial conditions than is possible in a full-time university undergraduate course. The paper describes two such courses offered at Enfield Technical College. Both courses have interesting features which make them different from the normal works-based sandwich course offered by many technical colleges.

THIS YEAR'S B.I.F.

The latest report from the management of the London Section of the British Industries Fair is that about eighty companies have taken space in the new Electrical Section at Olympia. Although these concerns are representative and will take most of the available space, there are some notable absentees. Some have remained faithful to the Birmingham Section, in the face of the general trend, but there are a number of previous exhibitors who still stand aside. Our feeling is that if there is to be an Electrical Section it should embrace at least all the leading electrical manufacturers, although we realise that there are countervailing considerations. It is necessary to stress the point that the B.I.F. is designed to stimulate export trade and that the Government-aided publicity in foreign countries is a valuable force in persuading overseas buyers to visit the display.

Rotary Printing Presses

Driving Methods and Equipment

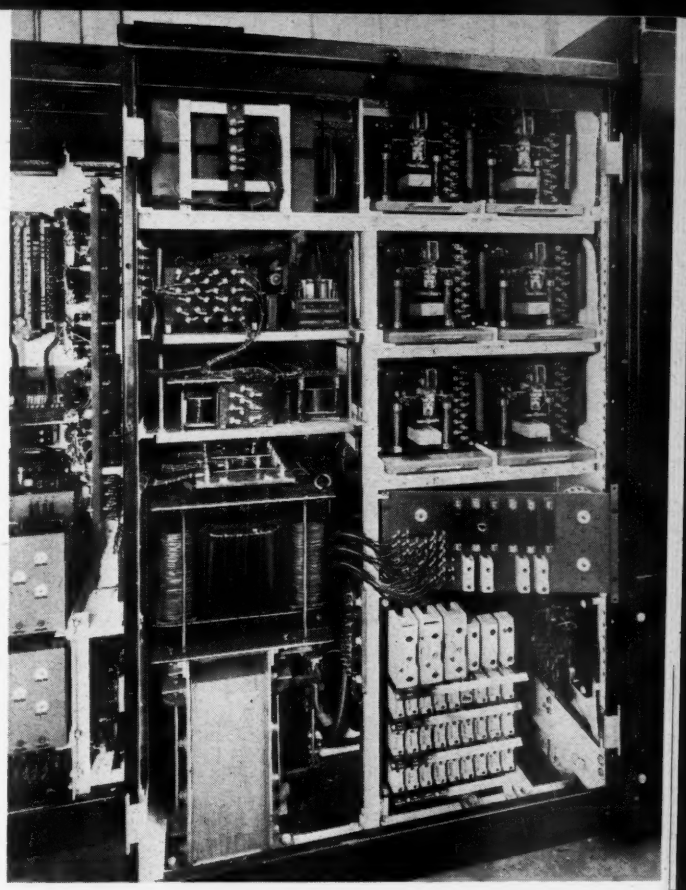
By F. W. RALPH*

THE modern rotary printing press does not differ essentially from the presses built upwards of 50 years ago, but many refinements and improvements have been introduced which provide greatly improved quality of product and rate of output, and greater convenience in operation. The improvements obtained have emphasized the importance of a special approach to the design of driving equipments for these presses.

The earlier rotary printing presses were driven by steam engines, but with the advent of electricity the use of direct current motors, generally with normal series and shunt control, soon became commonplace. The introduction of a.c. supplies led to the development and use of commutator motors as, at that time, a.c./d.c. conversion equipment of the required capacity was not sufficiently convenient or reliable.

In the United States the use of wound rotor slip-ring a.c. machines became commonplace, but they were not generally adopted in this country, nor, for that matter, in many other countries outside the United States, because of the loss of power which occurs if a printing press and the associated motors are run at less than maximum speed, when some rotor resistance remains in circuit.

The a.c. commutator motors for printing press drives were of three main types, Schrage, shunt and series, all of which are still in use to-day, speed control being achieved by brush-shifting gear. Each type has certain advantages in particular applications; for instance, the Schrage or shunt types are considered most suitable for group drives, in which one motor drives a number of printing units, all mechanically coupled to a folder. In these conditions, where varying loads may be presented by different combinations of units being used from time to



Ignitron and grid control equipment for rectifier, and magnetic amplifier for press motor field control

* Witton-James, Ltd.

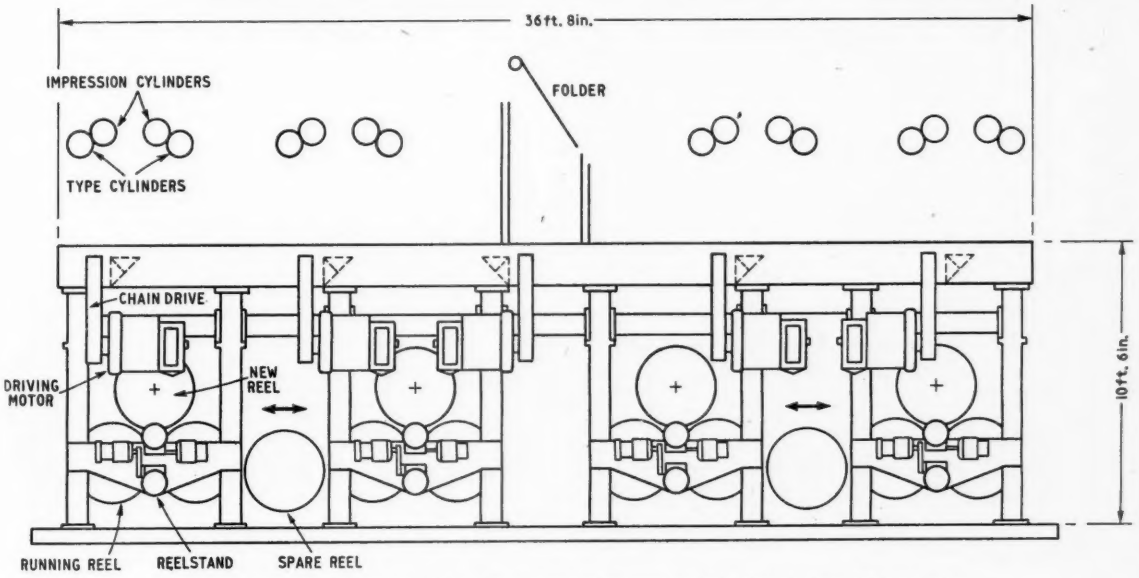
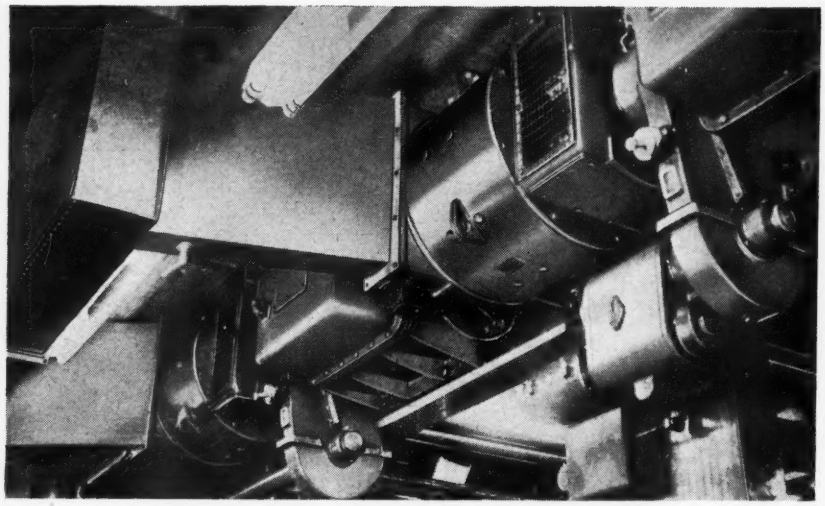


Fig. 1.—Layout of four units and folder of a rotary printing press capable of producing a 32-page paper



Co-axially mounted d.c. motors driving a rotary printing press

time, these motors best meet the requirement of a substantially similar speed for any given speed controller setting, regardless of varying load conditions.

On the other hand the series motor, which is of much simpler construction, is considered more suitable, by reason of its inherent load-sharing ability, for what is commonly known as the " unit " drive, where one motor is associated with each unit and folder, again all coupled together mechanically. The series characteristic usually presents no difficulty, so far as speed for any given controller setting is concerned, as each motor can be matched to its own load.

Mercury-arc Rectifiers

Each of the drives mentioned in the foregoing paragraphs has some limitations which are underlined by the more critical requirements of the modern printing press. This state of affairs, coupled with a general desire for higher operating efficiency and minimum complication of the driving equipment mounted on the printing press itself, led, as a result of the availability of convenient and reliable mercury arc rectifiers, to the introduction of the rectifier type of d.c. drive.

By this means the simple d.c. motor, or motors, can again be used, deriving armature supply from the controlled output of grid-controlled mercury arc rectifiers, continuous control of speed up to base speed of the motor being afforded in this way. Shunt field control is used for the rest of the speed range and is usually provided by varying the shunt field excitation by means of static magnetic amplifiers.

This form of drive was first introduced in the United States soon after the end of the second world war and rapidly gained popularity, partly due to the fact that the only other drive generally available for working from a.c. was the slip-ring induction motor, which was considered by many to be both inefficient and lacking in controllability, although admittedly relatively simple in design.

Almost immediately after the first installations of rectifier drives in the United States, great interest was expressed in the system by printing offices in the United Kingdom and other countries outside the American Continent. As a result rectifier drives were made available in Britain, some of them with an entirely different approach from the engineering aspect compared with those developed in the U.S.A. The first installations were put to work in this country five or six years ago, and since that time British-built drives of this type have become virtually standard equipment for many offices, both here and overseas, and increasing interest in their adoption is being shown by printing organizations.

The a.c. commutator type of drive is still used in many instances and in some cases the conventional d.c. drive also, but the rectifier d.c. drive is becoming standard equipment to an ever-increasing degree, even to the extent that many existing installations of conventional d.c. series and shunt resistance control equipments have been converted to rectifier type drives.

A typical arrangement of a modern newspaper press is illustrated in Fig. 1. In this machine a web of paper from a roll mounted in the basement is fed into each unit where it is printed on both sides and then passed to the folder for cutting, folding and delivery as a complete newspaper.

The print is applied to the web by semi-cylindrical stereo plates, clamped to one of a pair of cylinders, the other being a resilient-faced cylinder backing on to the web to bring about an " impression." There are two such pairs of cylinders in each unit to print both sides of the web.

Speedy fitting of the stereo plates to the plate cylinder calls for accurate " inching " or " jogging " of the press by the driving equipment to produce movement at the plate cylinder circumference in fractions of an inch, so that the cylinders can be precisely positioned to enable the plates to be locked by means of built-in clamps.

Once the plates are fitted, the web or webs are threaded through the press to the folder at a slow " threading " speed, usually between 30 and 40 ft/min, which, ideally, should remain steady and at the same rate notwithstanding any change in conditions which may occur from day to day. It is an advantage if, once the web is completely through the machine, this " threading " speed can be raised by the printers to speed up the process of preparing the press for printing.

Smooth Speed Control

Once the web or webs are set into the press, the machine should, again ideally, be brought to the normal printing speed in the shortest possible time in order to minimize the number of waste copies. Many of the copies printed during acceleration and deceleration may be out of register in printing or folding and therefore unsaleable.

Rapid acceleration of the press to printing speed and the reduction of waste copies are outstanding features of the rectifier type drive, for it provides virtually stepless and continuous speed control, at all times under the control of the printer, from the " threading " speed, of approximately 35 ft/min, to a maximum running speed which may be of the order of 1,800 ft/min or above.

Similarly, both when accelerating and decelerating from running speed to " threading " speed and when stopping for change of stereo plates or other reasons, it is important that the rate of speed change shall be substantially constant, for violent changes of speed can cause breakage of the webs. The consequent shut-down of the press and re-threading of webs may take some time and cause considerable loss of production.

In many conventional drives, both of the straight d.c. and of the a.c. commutator and wound rotor slip-ring motor types, the " threading " speed is achieved by means of a separate motor of relatively small h.p. rating. This drives the press through worm reduction gear and a free-wheel coupling, and when it is required to accelerate the press to printing speed, the main motors are switched in and take over control. This is known as " Duplex " equipment.

There are two weaknesses possible with this system, one being that due to lost motion in the reduction gear and free-wheel coupling, control of " inching " or " jogging " may not be very accurate. The other is that when the main motors take over from the small barring motor or motors, there is often a period of uncontrolled acceleration which can be excessive and produce difficulties in maintaining the webs.

" Single-motor " drives of the a.c. commutator type are available in which one motor performs all functions, including the " inching " and " threading " speeds, but both the motors themselves and the switchgear are inherently more complicated than with the Duplex equipments.

Advantages of " Single-motor " Drive

The conventional type of d.c. motor drive, the wound rotor slip-ring motor drive and in some cases the a.c. commutator motor drive, suffer from very marked series characteristics over part, if not all, of the speed range and this can be inconvenient in that changes of speed occur for any one setting of the speed controller if load changes arise through change of temperature, affecting the viscosity of the printing ink, lubricating medium, etc., and other conditions which may change during an edition or from day to day. The ink distribution in the printing units, for example, accounts for a very considerable proportion of the power requirements. Such changes of speed often entail re-adjustment of the press settings if the quality of the printed product is to be maintained.

The rectifier type d.c. driving equipment provides a satisfactory answer to these problems. It is a " single-motor " drive in that no additional " inching " or " barring " motors are required, whether with the unit type drive having one motor associated with each unit and possibly each folder or the group type with one motor associated with a number of units and folder. It uses a rotating machine which is inherently simple in construction and thus requires the minimum of maintenance—a most important feature when, as is common practice these days, motors are mounted in somewhat inaccessible positions.

With this form of drive, the armature supply to the d.c. motors is provided by grid controlled mercury arc rectifiers, and the field supply by a bank of selenium rectifiers. The output voltage of the armature supply mercury arc rectifiers is varied by means of the control grids and the output current of the shunt field supply selenium rectifiers is varied by a magnetic amplifier or transductor.

" Inching " and " threading " speeds, and all speeds up to base speed of the motor or motors, are achieved by varying the output voltage of the mercury arc rectifiers with the shunt field flux maintained at maximum. From base speed to maximum speed the output of the mercury arc rectifiers is maintained at the maximum and the shunt field excitation is reduced by means of the transductor.

The prime controlling element for both armature and field supplies is a rotary potentiometer having two sections ganged together on a common shaft and driven by a constant-speed pilot motor which is controlled from the push-button stations mounted around the press, so that the combined range of control is continuous and the press can be accelerated smoothly from " threading " speed to maximum speed and *vice versa.*

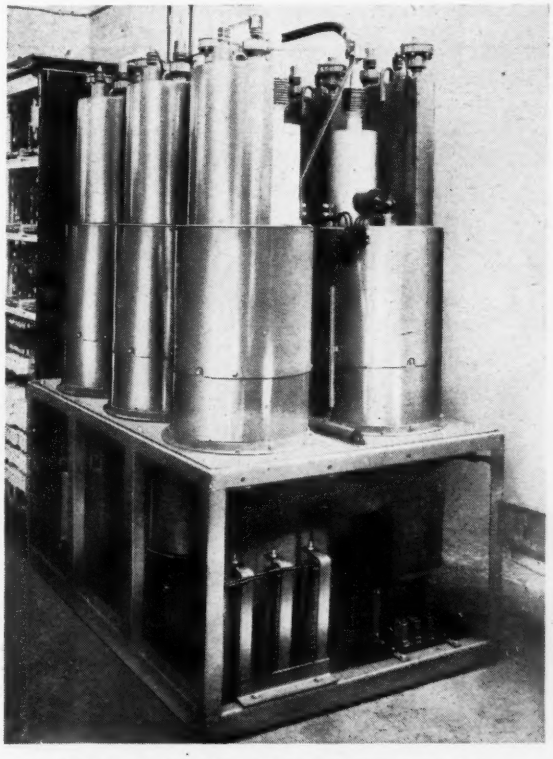
The d.c. motors are commonly designed with a 2 to 1 shunt speed range and, under normal conditions, actual running speeds fall within this range. In these circumstances, the rectifiers are providing full output voltage, i.e., they are not under grid control and, in consequence, are working at high efficiency, even under wide variations of loading conditions. The power factor is also extremely good. Over this range, the motors act in a conventional manner and provide the same degree of regulation as with the conventional d.c. driving equipments.

It may be noted here that with a.c. commutator and wound rotor slip-ring motors the efficiency and power factor vary with speed and load. Equipments are often designed to run at high speeds, but in practice are only run at between two-thirds and three-quarters of maximum speed, which method of working, particularly when combined with less than optimum load, can result in low power factor and efficiency.

The speed control of the rectifier drive below base speed is normally used only for smooth acceleration of the press up to base speed, which usually corresponds to the lowest normal printing speed. The control range available over this can, however, be valuable in certain conditions, as in colour printing, when fine control is of particular benefit in setting up a press.

Due to IR voltage drop in the armature windings, the motors have a pronounced " drooping " speed characteristic at the very low speeds required for " threading," but the grid control system for the armature supply rectifiers incorporates a self-regulating element which causes the armature voltage to be adjusted in sympathy with the load and this ensures that the motor speed remains constant, irrespective of changes in load.

Significant changes in load occur when, for instance, a press is run before the stereo plates are fitted, when there are no losses due to the impression, also when the blade



Bank of single-anode rectifiers for printing press drives

in the folder is actually cutting the webs into separate copies. In addition, it is necessary to develop something in excess of full load torque to overcome "stiction" in the press when starting up each time for "inching" or "threading."

The effect of this self-regulating system at the lower end of the armature speed range is to give the drive a shunt characteristic, but its effect tapers off as the speed is increased towards base speed until the characteristics become normal for a compound wound motor, as explained above.

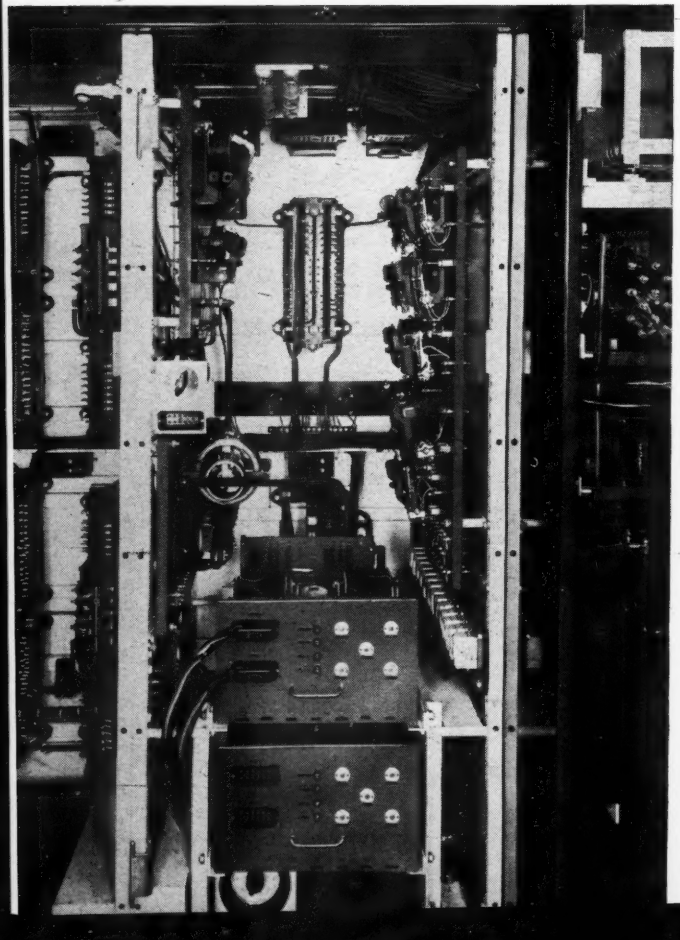
The motors are compound wound and so it is possible to achieve satisfactory load sharing over the shunt field regulation range covering the normal printing speed, between motors running in parallel and mechanically coupled together, but cross compounding is sometimes used to ensure the equalizing of the load over the whole of the speed range without the need for critical manufacturing requirements.

Hexaphase, Single-anode and Ignitron

The rectifiers associated with this form of drive may be of the widely used industrial form of hexaphase type mercury arc rectifier, in which there are six anodes and one cathode in one tank; the so-called single-anode type containing one anode and one cathode; or the ignitron type, again with one anode and cathode. The anodes of the hexaphase rectifier are connected to the three-phase supply through a 3/6 phase transformer, but the other types are connected in banks of six in a three-phase bridge arrangement and coupled direct to the three-phase (l.v.) network.

The hexaphase single tank rectifier and the so-called single-anode rectifiers are commonly air-cooled, whereas the ignitron rectifier is water-cooled. Apart from the difference in methods of cooling the hexaphase or single-anode mercury arc rectifier as against the ignitron, the outstanding difference is that the former types have no consumable components and have virtually infinite life, whereas ignitrons are definitely consumable. Each has some advantage over the others, but the type used with rectifier drive equipments in most offices outside the United States which have adopted this form of equipment is the single-anode air-cooled rectifier.

Printing press control cubicle



A typical installation in one of these offices consists of a bank of six single-anode air-cooled pumpless steel cylinder rectifiers in bridge arrangement which is connected through line reactors to the three-phase supply, and coupled on the d.c. side to a distributing busbar system in the main switchgear which may feed upwards of seven or eight 50 h.p. compound wound motors, each motor driving a printing unit or folder. The shunt fields of the motors are separately excited and fed from a self-excited magnetic amplifier comprising transductor and selenium rectifiers.

Variation of the armature voltage is brought about by grid control of the single-anode rectifiers, by a square wave signal voltage derived from a static phase shift network, by means of which it is possible to vary the phase of the square wave voltage with respect to the mains supply wave form. It is important that the wave form of the square wave signal should have a very steeply rising front to ensure accurate and close control of the rectifier firing under all conditions. A patented static phase shift network, incorporating square wave transformers, has been developed to meet this requirement, and provides a shift of approximately 120 deg with slightly under 5 W control power.

Variation of the phase of the signal applied to the rectifier grids with respect to the wave form appearing at the main anodes causes variation of the output from the rectifiers because of the varying utilization of the positive half-cycles at each rectifier anode. The degree of phase shift, and thus the output voltage from the main rectifiers, is determined by a control signal through the d.c. windings of saturable reactors forming part of the phase shift network, the value of this signal current being determined, in turn, by the input signal into a control signal amplifier which may be either electronic or magnetic or a combination of both.

The control signal applied to the input terminals of the control amplifier (left) represents the difference between a "reference" voltage which is derived from a potentiometer associated with the main push-button-operated speed controller and connected across a "reference" source; and a "reset" voltage which is some portion of the voltage appearing across the main d.c. output of the rectifiers.

To cause a voltage to appear at the d.c. armature busbars, a pre-determined "reference" voltage is applied to the system to produce a signal on the control winding of the phase shift network which advances the phase of the rectifier grid voltage. This advance of phase permits conduction through the rectifiers, which in turn causes a rise in busbar voltage, thereby increasing the "reset" voltage until the point is reached where this substantially equates with the "reference" voltage and the system then becomes stabilized in the selected condition.

Pre-set "reference" voltages are switched by relays to provide fixed busbar voltages for "inching" and "threading." When a "speed-up" push-button is operated, and the pilot motor drives the potentiometer away from the zero position, an increasing reference voltage appears at the input terminals to the control amplifier until maximum reference voltage is reached. The d.c. busbar voltage increases correspondingly up to the maximum value produced by full advance of the grid signals and full use of the positive half-cycles on the rectifier anodes.

To compensate for the effect of IR drop in the armature windings a further reference signal is added to that described above, and is derived from a d.c. current transformer or some other convenient means of obtaining an isolated voltage signal related to armature current. The combination of these two reference signals provides the means for achieving constant speed and response under varying load conditions.

The separately excited shunt fields of the press motors are connected to busbars fed from a bank of selenium rectifiers, the rectifier input being controlled by means of a 3-phase transductor (title picture) with its d.c. winding connected to the motor-driven field potentiometer.

Variation of the current through this d.c. winding alters the degree of pre-saturation of the d.c. reactor cores, connected one in each phase, and so varies their ability to pass current from the supply mains through the selenium rectifiers into the shunt field coils of the motors.

Interlocking and control relays are included in the system in the same way as with the alternative forms of drive, to provide push-button operation and other facilities in accordance with established printing house practice.

The use of electronics for controlling the drive of printing presses, although extensive, is by no means the only application of the science in this industry. Electronic methods are used extensively for controlling the automatic splicing of the web from one reel of newsprint to that from another at full printing speed; for detecting the breakage of a web during an edition and initiating the stopping and braking of a press; and for the many aspects involved in methods of "registering" the webs horizontally and laterally. Electronics are also used in the processing side of the industry. These few examples are sufficient to show the variety of purposes to which electronics are being applied, many of them highly specialized and peculiar to the printing industry.

District Heating in Pimlico

COSTS of construction and operation of the Pimlico (Westminster) district heating scheme were given in a paper presented at a joint meeting of the Institutions of Electrical and Civil Engineers on 31st January. The authors, Messrs Bryan Donkin (Kennedy & Donkin), C. M. Johnston (C.E.A.) and E. Ockenden (deputy city treasurer, Westminster), referred to a previous paper (Inst. C.E. 1954) describing the technical features of the undertaking which gave estimated costs only.

The financial results now given related to the twelve months ended 30th September 1953, the only year to date in which a constant number of premises was supplied with heat, then amounting to more than half the expected ultimate load. Heat supplied to Westminster City Council (metered at Battersea 'A' power station) was assessed at the cost of combined heat-electricity production less the estimated running cost of alternative condensing plant operating at an efficiency of 27 per cent.

Capital expenditure on heat-production, including 10 per cent for engineering and administration and capitalized interest, was £111,651 for plant, which was commissioned in 1951. This figure covered: two 1350 kW 10,000 r.p.m. back-pressure turbines, designed for initial steam conditions of 600 lb/sq in gauge and 800 deg F each giving 227·5 therms/hr of exhaust heat at 200 deg F at a back-pressure of 2 lb/sq in gauge; two 3.3 kV 1,500 r.p.m. alternators; two emergency steam-pressure and temperature-reducing equipments; two c.w. pumps and ancillary equipment. A heat exchanger, which was added in 1954, cost £12,100.

Electrical output (2,400 kW after allowing for auxiliaries) was governed by heat requirements of the Council; it was not credited with any kW capacity value, since it added nothing to the reliable kW provided, and was taken to be only the running cost of condensing plant generation. Overall costs were given on two bases. The first, or "direct", excluded fixed charges associated with the already existing boilers in Battersea "A", and did not affect the costs of electricity. On the second, or "allocated" basis, electricity supply benefited by being relieved of a small portion of the boiler house charges. In 1953 such charges were based on steaming capacity for the one turbo-alternator required to meet the load, but the ultimate scheme provided for two sets in operation. At the inclusive price of coal obtaining in 1953 of 82s6d/ton (12,755 B.th.u/lb) the cost per therm of 1,216,000 therms sent out from Battersea was 5.19d on "direct cost" basis and 5.39d on the "allocated" cost basis. At 100s/ton (12,500 B.th.u/lb) to compare with assumed price of coal for the completed scheme, these figures became 5.85d and 6.06d as against 5.33d and 5.58 for an ultimate output of 2,000,000 therms.

During 1953, the amount of heat supplied, mainly to 593 flats occupied by 2,190 persons in Churchill Gardens (Section 1) and Russell House, 1,200 flats occupied by 2,750 persons in Dolphin Square, amounted to 1,135,000 therms. The final figure was expected to reach approximately 1,870,000 therms.

Table I. Estimated capital cost of Heat Distribution

	Plant in use in 1952-53	Plant required for full development
	£	£
Tunnels	23,600	23,600
Reinforced concrete conduits ...	19,050	215,000
Pipes, machinery, and electrical equipment	79,950	
Heat accumulator	40,500	40,500
Pump-house and workshop building	16,150	16,150
Site of pump-house and accumulator	2,900	2,900
Miscellaneous	2,850	2,850
Interest on capital during construction	3,800	5,600
	188,800	306,600

The capital expenditure on heat distribution and storage is as set out in Table 1. The overall annual cost came to £17,100 in 1953 and was estimated at £28,500 on completion. Of these amounts £2,500 and £3,000 were in respect of operating wages, the substation being continuously manned. Loan charges were calculated at 3½ per cent for appropriate lengths of life of the various items of production and distribution equipment.

Overall costs per therm in 1953 of the district heating scheme, production and distribution, worked out at 9.8d on the district basis and 10.11d on the allocated basis. Corresponding figures for the finished scheme were estimated at 9.35d and 9.61d.

Electricity Supply Inquiry

HERBERT COMMITTEE'S VIEWS AND RECOMMENDATIONS

IN July, 1954, the Minister of Fuel and Power set up a committee "to inquire into the organization and efficiency of the electricity supply industry in England and Wales in the light of its working under the Electricity Act, 1947, and to make recommendations." The chairman of the Committee was Sir Edwin Herbert, LL.B., and among the members were Mr. J. W. G. Church, D.F.H., A.M.I.E.E., M.I.E.(India), formerly chairman of the Associated Electricity Undertakings in India, and Mr. L. W. Robson, chartered accountant, who is chairman of Associated British Engineering, Ltd.

Last week the Committee's report was published by H.M. Stationery Office (Cmd. 9672, 189 pp., 6s 6d). In the introductory chapter the Committee says that it viewed its terms of reference in the light of the Government's decision that the industry would not be denationalized and it examined no suggestion which would conflict with that decision. The main evidence was received from the Central Electricity Authority and the Area Boards but a number of other bodies and individuals (largely representing various classes of consumers) also gave evidence, among them being several electrical associations and trade unions. Many interviews were held with representatives of the Boards and visits were paid to a representative selection of districts and sub-areas of every Electricity Board and to the Generation Divisions.

Efficiency of the Industry

In its second chapter the Committee expresses its views on the meaning of "efficiency" in a nationalized industry, incidentally stressing the fact that the electricity supply industry is not using "public money" in the sense that any of its funds are derived from taxes or rates. Its loans have a Treasury guarantee but it should be the duty of the industry to see that the guarantee is not called upon.

It would be quite wrong to call the industry inefficient. While the cost of coal has risen by 270 per cent since 1939 and the cost-of-living index by 137 per cent, the average price of electricity has increased by only 30 per cent. The Committee doubts whether the ordinary domestic consumer has any idea of how cheap his supply of electricity is.

On the subject of "public accountability" the Committee expresses fears that it does not make for efficiency if every officer in every action has to be prepared to defend in public his every step. "If the public insist on having an answer on every point, which they would never dream of doing in a private concern, they must put up with the inevitable bureaucracy and rigidity they themselves bring into being."

As a monopoly the industry lacks the "classical spur to efficiency"—the possibility of failure or at least of showing up badly against others. With a constantly rising demand for electricity the industry has not known what real adversity means for many years. It was therefore necessary for the Committee to consider whether the forms of control used in the industry are effective in securing that money is not spent on unnecessary projects and that full value is had out of expenditure upon necessary projects. It says that it approached its task with only one object in mind—"the improvement and welfare of this great industry on which so much depends."

Several pages are devoted to a brief history of the supply industry and to the structure of the system and then the report deals with the principal problems facing the Central Authority and the measures taken to solve them. One outstanding point is that the industry has an annual capital investment of £200 million (over half on generation) representing some 8 per cent of the nation's total gross investment for all purposes or 19 per cent of the gross investment made by industry alone. Since nationalization the amount of generating plant available has not been sufficient to meet the maximum potential winter demand although the gap has become successively smaller. The C.E.A. has been restricted in its provision of plant by the Government's measures to apportion investment resources over the various national requirements and enforce a balance between home and export demands.

Methods of assessing future demand and plant requirements are reviewed by the Committee and it is shown how the various stages from the conception of a new power station to its completion may take as much as 7½ years. This is compared unfavourably with the speed of construction in the United States. Three ways are suggested of securing improvement:—The fostering of a keener competitive spirit among manufacturers; the facilitating of the grant of the necessary approvals; and by a freer delegation of responsibility for power station design from the Authority's headquarters to the Generation Divisions.

The major technical improvements achieved by the C.E.A. are reviewed, reference being made to the 275 kV "super-grid" and the raising of average power station thermal efficiency from 20·91 per cent in 1947-48 to 23·83 in 1954-55, thus effecting a total coal saving of 17 million tons and a saving in costs of about £53 million. The Committee mentions the tendency to install larger, more efficient sets up to 200 MW.

Purchase of Plant

A brief study is made of the Authority's bulk supply tariff and its effects upon Area Board finances and then contracts and purchasing arrangements are dealt with. In the fields which, because of price arrangements, there was little point in inviting competitive tenders the Authority has sought to strengthen its position in three ways. First it endeavoured to get manufacturers to expand their capacity or enter new fields of manufacture; secondly it obtained from manufacturers information on costs, prices and profits; and thirdly it sought to deal with the situation by allocation of contracts to nominated firms. The Authority considers that the competitive position has much improved lately and has decided to place future contracts on the basis of tenders invited in competition.

Engineering research by the Authority itself and by other bodies with financial assistance from the Authority is discussed and the allocation of funds for research in 1954-55 is shown in an appendix.

In a section dealing with the relationship between the Authority and the semi-autonomous Area Boards it is mentioned that the Authority has exercised its power to issue formal directions to Boards on only three occasions. It is pointed out that while the Boards and the corresponding Generation Divisions have joint regional labour relations bodies there is no common staffing or sharing of services between the two branches.

Surveying the character and organization of the Area Boards, the Committee refers to the three-tier structure commonly adopted (headquarters, sub-areas and districts) and says that some Boards have reached the conclusion that there should now be only two levels—headquarters and enlarged districts. The Committee found that most of the Board chairmen confined their attention to policy matters and left their deputy-chairmen to act as chief executive; their relative functions differed from Board to Board. The duties of sub-area and district managers, and chief officers of the Boards are discussed with an outline of methods by which contact is maintained between them and the Boards. It is shown that the district manager is most closely in touch with the public but he does not have full financial responsibility for the commercial success of his section of the undertaking. Remarks on " Problems and Progress " are devoted to integration of the separate pre-nationalization undertakings in an area; system development and reinforcement, with special reference to bulk supply points; expansion of demand and connections; rural electrification; connection charges; and standardization of tariffs.

Retail trading and contracting by the Boards is claimed by them to influence the standard of wiring and the promotion of the most suitable and efficient apparatus. They also maintain that consumers benefit from healthy rivalry between them and private electrical contractors and that they encourage a wider and more diverse use of electricity by the development and selective selling of appliances.

Industry's Personnel

The next section of the report deals with the personnel of the industry which at 31st March, 1955, numbered 179,171 and has been increasing in the last few years at the rate of 2,000 to 4,000 a year. The Committee says that the industry's success depends in the last resort on how efficient are the men who run it and how skilled are their leaders in managing men with widely differing backgrounds and varied qualities and qualifications. It therefore proceeds to turn its attention to the industry's training and promotion policy.

Brief details are given of the methods of recruiting and training craftsmen, students and graduates. There are at present about 5,500 craftsmen trainees, 1,500 student apprentices and 250 graduate trainees. The supply of craft apprentices is satisfactory but the Authority has some concern about the intake of the other two classes in which it has to compete with outside industry. Management courses and endeavours to give potential managers experience by interchange are mentioned.

There is no earmarking of individuals for particular jobs. Vacancies are advertised throughout the industry to ensure that nobody is debarred from applying for any post for which they consider themselves suitable. Senior posts are also advertised outside the industry. When their training is completed student and graduate trainees start at the bottom of the technical grades and compete with other employees and outside applicants for specific jobs as they arise. The industry's policy is to enable men and women at all levels to rise to the top by giving them opportunities for training both within and outside the industry.

Machinery for negotiating terms and conditions of employment is next dealt with and the five sections of this machinery covering all grades is specified. There follow some notes on joint consultation at national, district and local levels to consider matters affecting the safety, health, welfare, education and training of employees and to provide facilities for co-operation in obtaining greater efficiency and well-being in the industry.

Financial development and accounting procedure form the subject of the next section of the report. It is shown that the written down value of assets at 31st March last was £1,377 million and the installed capacity 20,173 MW. Substantial economies have been achieved by standardization of equipment, through the national planning of new transmission and bulk supply points and by the reduction of stocks and stores. It is estimated, for instance, that the new 275/380 kV super-grid will yield a net saving of some £37 million by reducing expenditure on certain generating and transmission plant.

Although the Area Boards have been given a high degree of financial autonomy their capital budgets have to be submitted to the Central Authority which enables the latter to settle with the Ministry of Fuel and Power and the Treasury the finance requirements of the industry for the following year. Money is raised by the issue of relatively short-term Electricity Stocks at about the current gilt-edged market rate. At present £1,166 million of stock (including £341 million compensation stock) is now outstanding.

The total capital requirements for distribution during the first seven years of operation, including working capital, was £463 million of which £223 million (about 49 per cent) was provided from the internal resources of the Area Boards.

Depreciation policy was a particularly difficult problem for the electricity supply industry because of the high ratio of capital investment to income. The fixed assets taken over by the Boards were valued at £406 million but their replacement value could not have been less than £1,000 million. Nevertheless it was decided to depreciate all fixed assets on a straight line method based on " historical " cost. The view is taken by the Central Authority that the gap between this provision and replacement cost will become less and less significant in view of the rapidly increasing proportion of assets being depreciated on post-war prices as a result of the heavy capital expansion since vesting day. From vesting day to 31st March last £195·27 million was provided for depreciation on vested assets and £93·52 on post-vesting expenditure—a total of £288·79 million; it was not until 1954-55 that additional provision (£10·5 million) for the replacement of fixed assets was made. The present inflationary trend has a definite bearing on this problem, for experience shows that actual expenditure has appreciably exceeded the original estimates.

Reserve Funds

Dealing with reserve funds the Committee states that but for taxation relief in regard to capital allowances the total reserves (standing at £50·8 million on 31st March last) would have amounted to no more than £42 million, equivalent to only 2 per cent of the combined revenue. The Central Authority now builds up capital reserves by means of a fixed margin in the bulk supply tariffs and the Area Boards are left free to build up their own individual reserves.

Operating results are reviewed to show that the Central Authority and Area Boards earned a revenue of £1,896·9 million in their first seven years and had a consolidated net surplus of £60·3 million. Figures are given of the Boards' revenue from retail trading and contracting.

Particulars are given of budgetary control and accounting procedure and the Central Authority's decision to place insurances with the ordinary market instead of carrying its own risks is noted.

Part IV of the report is headed " Appraisement " and it deals first with the structure of the industry. The subject of the separation of generation and distribution is discussed. It is considered prima facie uneconomical to have two

organizations in an area, one dealing with generation and the other with distribution. There is great force in the argument that power stations exist to supply the Area Boards with the electricity which they need to discharge their obligations to their consumers and that if those responsible for the commercial side were also responsible for the construction and operation of the power stations there would be a considerable incentive towards economy. This is the view of some Area Board chairmen but other chairmen would prefer to have the undivided responsibility of distribution without the added responsibility of generation. It is said, however, that few, if any, of the chairmen are satisfied with the present arrangements.

The Committee, although impressed by these arguments, has come to the view that on balance the separation of generation and distribution is sound and should be continued with the proviso that any central organization controlling the power stations and grid should be able to offer electricity to an Area Board more cheaply than the Board could supply it for itself. If, in unusual circumstances, this may not be the case the Committee implies that there is no reason why a Board should not produce some of its electricity instead of buying it. Five conditions in which a Board might wish to do this are put forward. Three of them relate to possible cheapening of supply and are not considered to have much force. The fourth—the combination of small-scale generation with the sale of power station heat—is thought to be feasible. The fifth condition is the possible dislike of a Board to be dependent on another body even if economics were against it. While the Committee recommends that Area Boards should be given the power to generate for their own networks, the power should be used exceptionally and subject to approval of the particular scheme.

Attention is drawn to the great increase in the headquarters staff of the C.E.A. and to the feeling of most Area Boards that the Authority interferes too much in their affairs. Some divisional controllers feel that they are not given sufficient responsibility in the design and operation of power stations and that there is an unnecessary amount of duplication of work. Another complaint is of the immense amount of work and responsibility shouldered by the chairman and the two deputy-chairmen of the C.E.A. and the considerable amount of time spent by members and chief officers of the C.E.A., Area Board chairmen and divisional controllers in attending headquarters conferences and committees. Similar criticism is made of the conduct of Area Board affairs.

Division of C.E.A. Functions

The Committee refers to the dilemma of Area Board chairmen in having to discuss Area Board work at headquarters conferences and to the view of the chairman of the Central Authority that the Boards should not vary in any important particular their original organizational structure. Objection is raised even to the substitution of a two-tier instead of a three-tier system without the Authority's approval and this is resented by the Area Boards. There is also resentment at the fact that the Central Authority controls the cost and price of electricity at every level.

A good many of the objections to which the Committee draws attention result from the mixture of executive and supervisory functions within the Central Authority. While the Committee thinks that the existing Area Board pattern should be retained, in its opinion it is essential to separate the two functions of the Central Authority. The construction and operation of power stations, the grid and super-grid, and the supply of power in bulk should be placed in the hands of a new statutory corporation which might be called the "Central Electricity Generation Board". It is considered necessary to retain a Central Authority to exercise supervision over the industry.

A reconstituted Central Authority should:—(*a*) approve the general plans of the Generation Board and the Area Boards and approve any proposal by an Area Board to construct a power station; (*b*) approve their capital and revenue budgets and authorize stock issues; (*c*) approve depreciation and reserve fund policies; (*d*) approve retail tariffs and the bulk supply tariff; (*e*) approve the Boards' research arrangements; (*f*) consider complaints by Consultative Councils or consumers; (*g*) supervise labour relations machinery; (*h*) require from the Boards information necessary to enable the Central Authority to perform these functions.

The Committee suggests that this Central Authority should have a chairman and two other full-time members and four part-time members. The Authority should be required annually to produce and publish reports and statistics covering the whole industry.

Generation Board's Responsibilities

The Central Electricity Authority Generation Board should have a full-time chairman completely free of special duties and from four to six other members, mainly full-time. It is thought that the establishment of the Generation Board with executive responsibility for the design, construction and operation of power stations and the grid would go some way towards avoiding a number of objections to the present system. It is noted with approval that there is now a tendency to give station superintendents greater responsibility.

After reviewing the matters for which the C.E.A. and Divisions are responsible the Committee says that as a general principle no duties should be assumed by headquarters unless it is clearly demonstrable that they are better performed there than in the Divisions. It sees little advantage in the interpolation of a regional management board between the Generation Board and the divisional controller on the lines of that established for the combined North West, Merseyside and North Wales Division.

It is considered that responsibility for the design and construction of " conventional " power stations involving no novel future should lie with the Division, subject only to headquarters approval of the site, capacity and amenities of the station and of any proposals to employ consultants. The construction of " advanced " stations (including nuclear stations), incorporating features which are outside common practice for the time being, might be undertaken by headquarters through mobile construction teams. When not so engaged, these teams should be available to assist Divisions where the weight of " conventional " construction is disproportionately heavy. Current developments in electricity supply are expected to necessitate a further review of the Divisional organization by the proposed Generation Board.

While it is for each Area Board to determine the best form of internal organization the Committee makes suggestions for the Boards' consideration. Certain specialist services should be concentrated at a limited number of service points in the Area, available to any management unit of the Board. There should be only one management level below headquarters and the number of genuine management districts should be increased to perhaps fifteen or twenty in each Area. These management districts should be identified with the locality served and described as " undertakings". Below these undertakings and responsible to them the organisation should consist of outlying engineering sections and electricity service centres.

District managers should be given full responsibility in their own districts and their posts should be used as a training and testing ground for higher managerial positions.

The Committee does not agree with the establishment of a Welsh Electricity Board responsible for both generation and distribution. A single distribution board for Wales appears practicable but the existing Area Board organization should not be disturbed unless Welsh consumers are ready to pay the probably increased costs.

Board Members' Salaries

Dealing with the remuneration of members of Boards the Committee says that the electricity supply industry must compete with private industry for its top management and will be handicapped if it cannot offer comparable salaries. It expresses the view that the salaries of the chairmen and full-time members of the Central Authority should be at least £10,000 and £8,500 respectively and the salaries of the chairmen and full-time members of the Generation Board should be at least £8,500 and £7,000 respectively. The post of Area Board chairman should command £6,000 for a full-time and £3,000 for a part-time appointment, and the remuneration of other part-time appointments to the Central Authority and Boards should be at least £2,500 and £1,000 respectively. The Committee also suggests that the chief executive should not normally be paid substantially less than the salary proposed for a full-time Area Board chairman.

The present requirement that the Minister shall consult the Central Authority before he makes Area Board appointments should be abolished. The post of Area Board chairman should be converted, as opportunity offers, into a part-time appointment and it would be inadvisable for the Area Board to contain any full-time members other than the chief executive; the office of deputy chairman should accordingly lapse. The industry should urgently review the conditions which are causing well qualified men with the calibre of potential leaders to turn away from the industry and should improve the terms of service, including starting salaries and differentials, for graduate trainees. The industry should have a deliberate system of selective training and posting of able young men in order that potential leaders may prove their qualities in successive positions and gain the experience which will fit them for higher management.

The Authority's passive attitude towards redundancy is criticized; the Committee says that the industry should adopt a more realistic attitude and establish what re-deployment is necessary for efficiency. Redundant staffs who cannot be transferred to other work should be released on generous terms to facilitate their absorption into other industries.

The new Central Authority should insist upon proper operational research and work study being undertaken as a condition of approving budgets, and the Electricity Boards should study with the trade unions the formulation of schemes of merit pay and incentive payments.

Boards' Finances

Upon the subject of finance the Committee says that the Central Authority should require each Area Board and the Generation Board to ensure that their revenues are sufficient to meet their outgoings, taking one year with another. The existing central reserve fund should be distributed among the Generation Board and the Area Boards and a proper apportionment made of other assets and liabilities of the Central Authority between those Boards. The removal of the Central Electricity Authority's responsibilities for generation should leave it freer to supervise Board finances. District managers should be given the necessary accountancy service for the exercise of full financial responsibility and divisional controllers should produce balance sheets and operating statements for the Generation Divisions.

The price charged for electricity should be sufficient to recover from consumers the real value of the resources used up each year in serving them but to avoid the need for violent or frequent tariff adjustment a contingency reserve should be built up. Before resorting to the raising of prices to secure a higher margin the industry should make a much more vigorous attack on costs, including the utilization of capital and man-power.

Beyond the level suggested, the industry should not build up reserves for financing its own expansion. The efficient use of capital would be encouraged if the Boards had to compete for funds on the market without the support of the Treasury guarantee.

The Committee approves the practice of the Boards in requiring new consumers to contribute towards the costs of connection if the anticipated revenue is not high enough to cover these costs in the long run. In considering the rate at which rural or other developments should proceed each Board should apply normal economic and commercial tests. If any Board finds itself unable to advance rural electrification at the planned rate without financial difficulties it should re-examine its policy as to the scale of initially unremunerative development and the charges for connections. If Parliament decided in the national interest that the Boards should undertake unremunerative work the cost should fall on the national Exchequer.

It is considered that the structure of the present bulk supply tariff is basically sound but the revision of the regional fuel clause should be effected without undue delay, and the Central Authority should consider varying the unit charge of the tariff for supplies taken by Area Boards as between day and night and between summer and winter, to reflect the difference between peak and off-peak costs.

Costs and Tariff Structure

The industrial maximum demand tariffs come nearest to reflecting the cost of supply, especially after recent developments distinguishing between high and low voltage supplies and between good and poorer load factor supplies. The Committee is not satisfied that the commercial, domestic and farm tariffs reflect as closely as practicable costs of supplying these classes of consumers. An inquiry should be made to determine whether more valid bases can be chosen to measure the costs of supplying the varying types of consumers now grouped within the commercial class. The Committee thinks that domestic consumers as a class are not contributing as much as they ought towards the costs of their supplies and there should be an investigation into the possibility of applying a coal clause to domestic tariffs.

It is recommended that investigation should be made into the possibility of designing cheap meters to enable maximum demand tariffs to be offered to the smaller commercial and farm consumers with loads down to 5 kW. There should also be further research and experiment with tariffs and metering to enable the larger domestic consumers to be offered tariffs which would reflect their individual loads on the system.

A thorough investigation of the problem of improving load factor should be undertaken urgently and the Electricity Boards should be more vigorous in promoting sales to all classes of consumers in off-peak periods.

In discussing the subject of allocation of contracts the Committee has asked why, as a check upon tenders from home manufacturers, the Central Authority did not invite tenders from abroad. It was told that it would be unwise for the Authority to be dependent upon foreign manufac-

turers for spares and maintenance; moreover the Government would look with disfavour on any proposal for heavy electrical plant orders being placed abroad. The Committee challenges the Authority's attitude that it would not invite foreign tenders because it would not be in the national interest to do so and says that the Electricity Boards should seek the best and cheapest plant, taking maintenance and servicing into account, irrespective of origin.

The Committee recommends that the operation of the labour relations machinery, in concert with the trade unions, should be the responsibility of the Generation Board and Area Boards. As regards the Consultative Councils a reduction in local authority representation is suggested while the representation of industry and commerce should be increased.

Retail trading and contracting by the Electricity Boards is commended. Each Board should appoint a senior officer, under the chief commercial officer, to direct policy and each district should produce its own accounts and retail trading and contracting should be individually costed and be the subject of separate accounts.

Greater research and development efforts are called for. On the generation side research and development should be brought together under the full-time member of the Generation Board responsible for these matters and he should be supported by a high quality research staff. The Area Boards should extend their research activities individually, in co-operation with other Boards, and by association, where appropriate with the Generation Board.

The Committee expresses approval of the Central Authority's decision to build a limited number of nuclear power stations. It thinks that the Nuclear Power Branch established by the Authority should be strengthened and become responsible for the construction, operation and development of these stations. Its head should have the status of a deputy chief engineer of the proposed Generation Board.

Finally the Committee expresses the opinion that the powers of direction possessed by the Ministry of Fuel and Power should be retained.

A number of useful appendices are included with the report.

LORD CITRINE'S STATEMENT

Commenting upon the Herbert Committee's report Lord Citrine, chairman of the Central Electricity Authority, said that it was a challenging and stimulating report. Everyone in the industry must appreciate the sincere attempt which the Committee had made to deal with a wide range of very complicated and difficult subjects and of the manner in which this had been done, having regard to the limited time available.

The report was stimulating in its recognition that this was an efficient industry and in the proposals it made aimed at improving efficiency still further. A dynamic industry, such as electricity supply, could not stand still. New developments, new practices and methods were constantly being devised, tested and applied. There was much in the report in respect of policies of management, tariffs, finance and organisation which would assist constructive action. Many of the recommendations appeared to be in line with changes which the Authority had already considered but held up in order to have the benefit of the Committee's views. Some of the other recommendations were of such a far-reaching character that if carried out would be bound to cause repercussions throughout the industry.

The report was being studied in detail and the Authority's comments would be made as early as possible. It must be remembered that the full evidence upon which the conclusions were based was not available to the Electricity Boards or to the public. They hoped to be able to meet the members of the Committee for an informal discussion of their observations. It was evident that the report was not intended to create the impression that there was anything seriously wrong with the industry. Its purpose was to show how it might be made still more efficient. They would approach the report with the desire to secure the advantages of any changes which the Committee proposed and were shown to lead to higher efficiency, better service to the public and more harmonious industrial relations.

Particle Accelerators

IN an informal lecture to the Radio and Measurements Sections of the Institution of Electrical Engineers, Mr. E. R. Wiblin listed the main uses of particle accelerators as the production of: neutrons of defined and variable energy; higher-energy (mesic) particles in the quantity and at the place desired; electrons or x-rays as neutron generators in therapy and industrial irradiation. Among problems discussed were adequacy of screening of high-intensity energy and prevention of deterioration of organic materials used in electric insulation and paints.

In assessing the neutron properties of reactor materials, one consideration was that the passage of neutrons through the air was rapidly attenuated above a few metres, but distances (for accurate time measurement) of up to 500 metres were required, which called for large high-vacuum tubes. The alternative was a supply of a noble gas, such as helium, and a large " nylon stocking ".

Regarding the reliability of modulators for radio-frequency sources, in the present Harwell accelerator one ignitron was used with a life of 150 hours on pulse duty, which necessitated a valve change once a week with three-shift operation. For normal electronic units, upwards of 1,000 valves and associated components might be in use at any one time, so that lives of 1,000 hours meant a valve change every hour on an average.

In the subsequent discussion the need for ignitrons of 150 hours' life was questioned, as a large hydrogen thyratron lasting over 1,000 hours would serve the purpose. The main factor governing reliability was the service life of valves, which were considered to be run too close to their operating limits. Replacement of valves by transistors having a lower power drain was suggested. Cost of shielding and housing amounted to half that of the accelerator itself, but the efficiency of concrete might be improved by raising its density to 4½.

Efficiency of conversion of radio-frequency power to electron beam power, which in early machines was only 15 per cent, had been raised to 25 per cent for the standard 15 MeV machine, while for a new machine under construction it would be 75 per cent. The first unit to be used solely for industrial radiography would shortly begin operation in Britain. Steel castings 1 ft thick could be penetrated in one hour's exposure by high-energy radiation, whereas by existing methods six months would be required.

Austrian Production and Imports

In the article bearing this title in our issue of 20th January the figures of United Kingdom exports to Austria given in Table 1 (page 113) are in hundreds, not thousands, of pounds sterling.

VIEWS on the NEWS

By REFLECTOR

THOSE who advocate that scientists and engineers should have some grounding in the " humanities " will be gratified by the attempt now being made by the Imperial College of Science and Technology to attract a number of young people leaving school who have specialized on the arts side. They will be expected to have reached advanced level in two subjects from the humanities and the ordinary level in mathematics in the General Certificate of Education. It is intended to give these students an intensive first-year course of mathematics, physics and chemistry and they will then join others who are reading for science degrees and normally they will graduate in three years. It will be interesting to see the results of this inversion of the usual arrangement by which the humanities are superimposed upon men who begin on the science side.

* * *

A reader in Trinidad (Mr. D. P. J. Brook, B.Sc.(Eng.), A.M.I.E.E.) has seen my notes and recent correspondence upon the location of buried cables by " divining " methods and says that the method was introduced to him a few years ago by an Englishman resident in Trinidad. He was, he says, amazed to find that it worked and mentions that a buried telephone cable whose course was roughly known was found in a few minutes about 8ft away from the indicated spot. I don't know whether I ought to consider this a good result. Mr. Brook tested his local staff and claims that there was a reaction in about three-quarters of them—" the remainder either not having the amount of faith which surely must be required—or is there a really satisfactory explanation of the appreciable forces which appear to be set up in the two bent wires? "

* * *

Several times in recent weeks I have heard complaints that while Electricity Boards are unable to reinforce their networks, as a result of which breakdowns are becoming too frequent, they are still selling electrical appliances. These complaints are justified at first thought but there are certain other aspects of the matter to be considered. In the first place the appliances may merely be replacements of existing ones in which case they make no difference to the load. Then it may be asked whether new houses equipped for the use of electricity should be barred from using it. In other cases it may be suggested that gas or solid fuel should be used as an alternative; but are the Gas Boards in any better case? And are solid fuel supplies so certain? The complaints really lie against the Treasury which has decreed that expenditure upon electricity supply should be limited. The first call upon finance has had to be made for generating plant and in consequence the distribution systems, which badly need strengthening, have had to go short.

* * *

Apropos the remark in the foregoing paragraph about solid fuel I may refer to a letter from Mr. J. S. Williams, the director of the Coal Utilisation Council published in the *Birmingham Mail*. That paper had suggested in an article that before long the domestic hearth would disappear and town houses would all be heated by electricity. Mr. Williams quotes the Ministry of Fuel and Power as stating that continuous heating costs two and a half times as much as the use of solid fuel in a modern fire or stove. There is much virtue in the word " continuous." I doubt whether continuous heating is necessary in the majority of homes. Further than that, I doubt very much whether solid fuel at around £8 a ton, even when most efficiently burned, is so overwhelmingly cheaper than electricity, and much of the coal obtainable nowadays is not what the coal industry calls " solid fuel."

* * *

I have been shown a letter addressed to the Editors by a schoolmistress. This lady is preparing pupils for an advanced geography examination which apparently includes knowledge of local conditions. She therefore needed some information on electricity supply in the area and naturally applied to the appropriate Electricity Board, only to be told, she says, that they could not supply the information. But they were not entirely unhelpful: they referred her to the *Electrical Review*. She did this and was helped. No doubt the Board's action was very flattering to the *Review* but it seems a little strange.

* * *

The following story comes from the " East Midlands Electricity Journal ":—

> " Letter to a business firm: ' Our electronic brain computes that the cost of the project under negotiation will be £10,000.'
>
> " Letter from a business firm: ' Our electronic brain finds this estimate far too high. We suggest a meeting between them at the earliest . . .' "

* * *

" An Old Reader " wrote to the *Electrical Review* of 9th February, 1906, on London's street lighting. He said:—

> " I have no doubt that Londoners, who take a pride in their City, will welcome the proposal of the City of London Electric Lighting Co. to light several streets at its own expense. If it should bring about the removal of those wretched incandescent gas lamps, which at present disgrace Fleet Street and other streets, it will be a move in the right direction. It is strange that London should be so far behind provincial towns as regards street lighting. The ugly gas lamps recently erected in the City are only to be found in side streets in many provincial cities. In Leeds gas lighting is dying out fast, and electric light seems to be everywhere; not only all the central thoroughfares, but many side streets, are now bright with electric light, and in no town in England is there a square as brilliantly lighted as Victoria Square, Leeds. The gas lighting papers still continue to find fault with electric light, and will do so as long as people are foolish enough to believe their misleading reports."

PERSONAL AND SOCIAL

News of Men and Women of the Industry

The British Thomson-Houston Co., Ltd., announces the appointment of **Mr. D. N. Relf,** M.B.E., A.M.I.E.E., as manager, Transformer Contracts, and **Mr. I. A. Ferguson,** M.I.E.E., as manager, Mining Department, in succession to **Mr. G. W. Edgley,** who has relinquished the management of both departments before taking up another important appointment with an associated company.

Mr. Relf completed an apprenticeship course at the B.T.H. Willesden Works in 1930 and then entered the drawing office, being transferred to the Engineering Department in 1938. Following war service as a flight-lieutenant in the R.A.F. he rejoined the B.T.H. Co. in 1946 in the Switchgear Contracts Department. In 1950 he assumed executive responsibility for the Export Section of that department, in which capacity he travelled

Mr. D. N. Relf

Mr. I. A. Ferguson

overseas on the company's behalf. He was appointed assistant manager, Switchgear Contracts, in May last year.

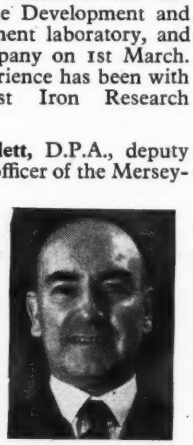
Mr. Ferguson was educated in Glasgow, first at Kelvinside Academy and afterwards at the Royal Technical College. He joined the B.T.H. Co. as an apprentice and on completing his course spent two years in the Construction Department as a district engineer. From 1941 to 1946 he served in the Royal Navy as sub-lieut. (E) R.N.V.R. and after the war he rejoined the company in the Plant Contracts Department. In 1948 he became a senior engineer in the Mining Department, being appointed assistant manager in 1954. Mr. Ferguson has made several visits to South Africa, the Rhodesias, and the Continent on mining business. He is an associate member of the South African Institute of Electrical Engineers and a member of the Association of Mining Electrical and Mechanical Engineers.

Mr. H. Foster-Smith, M.C., M.I.E.E., has returned from a year's assignment in Venezuela for the United Nations where he has been acting in an advisory capacity on electrical power development. On his return to the Central Electricity Authority he was asked to take up duties at headquarters, Bankside House, London, and has been transferred from the Birmingham regional office.

Dr. John Lamb and **Dr. J. H. Westcott,** lecturers at the Imperial College of Science and Technology, have been appointed to University readerships in electrical engineering tenable at the Imperial College.

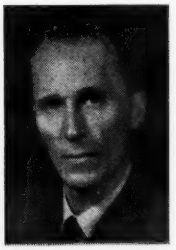
The Development and Research Department of the Mond Nickel Co., Ltd., announce the following new appointments:—**Mr. G. L. Harrison,** A.I.M., will succeed Mr. A. D. Busby as a development metallurgist in London, where he will be working in the cast iron field. His previous experience has been with Sterling Metals Ltd., John Wright & Co. Ltd., Ouzledale Foundry Co. Ltd., and Alfred Herbert Ltd. **Mr. P. D. Wilmot,** B.Sc., is joining the company on 1st March as a development chemist. He will be concerned with the chemical and chemico-physical aspects of the work of the Development and Research Department. He is at present in the Research Department of Monsanto Chemicals Ltd. **Mr. J. H. Gittus,** B.Sc., has been appointed section leader of the cast iron section of the Development and Research Department laboratory, and will join the company on 1st March. His previous experience has been with the British Cast Iron Research Association.

Mr. J. W. Kellett, D.P.A., deputy chief commercial officer of the Merseyside and North Wales Electricity Board, has been appointed manager of the Board's No. 3 Sub-Area. He succeeds Mr. T. Coates, who is now deputy chairman of the North Western Electricity Board. Mr. Kellett was educated at Merchant Taylors' School. He commenced service with Liverpool Corporation in 1916 when he joined the costs section of the City Treasurer's Department. After war service with the Royal Flying Corps and the Middlesex Regiment, he returned to Liverpool Corporation and in 1928 was appointed head of the costs, wages and stores section of Electricity Accounts. In 1935 he became the commercial assistant to Mr. P. J. Robinson (then city electrical engineer), and at vesting date was chief commercial assistant to the Liverpool electricity undertaking. From vesting day until October 1948, Mr. Kellett was acting chief commercial officer and assistant sub-area liaison officer with the Merseyside & North Wales Board.



Mr. J. W. Kellett

Mr. A. C. Franklin, M.I.E.E., M.Am.I.E.E., has been appointed assistant general manager and an executive director of Bonar, Long & Co., Ltd. Mr. Franklin was previously chief designer, Transformer Department, with Johnson & Phillips, Ltd., the company with which he started his technical training as an engineering apprentice. He has served on numerous B.S.I. and B.E.A.M.A. Technical Committees.



Mr. A. C. Franklin

Mr. W. Hutter has joined Auto Diesels as home sales manager for "Stad" industrial engines. Mr. Hutter was previously London representative for Petters, Ltd., and before that was on the experimental staff of Bryce Berger, Ltd.

Mr. D. W. Heightman, M.Brit., I.R.E., has recently resigned the position which he has held since 1950 as chief television receiver engineer of the English Electric Co., Ltd., and has joined Radio Rentals, Ltd., as chief engineer to the group.

Mr. A. R. Rumfitt, A.M.I.E.E., technical manager of the Yorkshire Switchgear & Engineering Co., has been appointed sales manager of the company.

Mr. J. L. Rowbotham has been appointed a director of the Hackbridge & Hewittic Electric Co., Ltd.

The following senior appointments and promotions in the organization of Hoover, Ltd., are announced:—**Mr. R. T. Griffiths** home sales manager becomes general sales manager (home) and a director of Hoover (Washing Machines) Ltd.; **Mr. V. C. Mumford,** export manager is appointed general sales manager (export) and a director of Hoover (Washing Machines) Ltd.; **Mr. R. L. Webster,** chief personnel manager, has been appointed a director of Hoover (Washing Machines), Ltd.; **Mr. G. J. Hemmings,** manager of L'Etablissement Hoover S.A., Brussels, is now general sales manager (continent), controlling all Hoover

Continental business except that in France; **Mr. A. W. Bunn,** sales promotion manager is promoted to sales manager and deputy general sales manager (home); **Mr. P. M. J. Evans** divisional manager, Export Department, becomes export sales manager and deputy general sales manager (export); and **Mr. G. S. McNamara,** divisional manager, Export Department, is now export sales promotion manager.

Mr. H. W. Hoover who in 1954 succeeded his father, the late Mr. H. W. Hoover, senior, as president of the American Hoover Co., has become chairman of Hoover Ltd.

The Council of the Institution of Electrical Engineers has elected **Colonel Sir Arthur Stanley Angwin,** K.B.E., D.S.O., M.C., T.D., D.Sc.,(Eng.), a past-president of the Institution, to hon. membership in recognition of his outstanding life's work in the field of telecommunications, both national and international, and of his distinguished services to the Institution.

The Council has also made the thirty-fourth award of the Faraday

Sir Stanley Angwin

Prof. G. W. O. Howe

Medal to **Emeritus Professor G. W. O. Howe,** D.Sc., LL.D., for his pioneering work in the study and analysis of high frequency oscillations and on the theory of radio propagation and for his outstanding contributions to engineering education.

One of the Capper Pass awards made jointly by the Institution of Mining and Metallurgy and the Institute of Metals has been given to **Dr. Maurice Cook, Mr. C. L. M. Cowley** and **Mr. E. R. Broadfield** for a paper on "The Use of Refractories in Low-frequency Induction Furnaces for Melting Copper" published in the *Journal* of the Institute of Metals.

Mr. C. Cridland, chairman of Aldis Brothers, Ltd., and president of the Scientific Instrument Makers' Association, has been elected Master of the newly formed Guild of Scientific Instrument Makers. The senior warden is **Mr. J. E. C. Bailey,** and the junior warden, **Mr. C. A. Whipple.**

Mr. J. A. Burgess, manager of the Liverpool Branch of Walsall Conduits Ltd., has retired owing to ill health after a service of more than forty years with the company. He is succeeded by his son, Mr. H. Burgess who has been at the Liverpool Branch for twenty-one years.

The Metropolitan-Vickers Electrical Co., Ltd. announces that **Mr. J. Titterington,** Assoc.M.C.T., M.I.E.E., has been appointed assistant chief engineer, Motor Department, as from 1st January. Mr. Titterington received his technical training at the Manchester College of Technology and after completing his apprenticeship with Metropolitan-Vickers he joined the Motor Engineering Department, where for the last ten years he has been in charge of technical service work. He has visited Holland and North and South America in connection with the company's work for the oil industry.

Mr. J. Titterington

The North Western Branch of the **Electrical Trades' Commercial Travellers' Association** will hold its ladies evening on 27th March at the Alma Lodge Hotel, Hazel Grove, Stockport. Tickets (27s 6d each) are available from the hon. social secretary, Mr. K. Snelson, 15, Ridge Crescent, Whitefield, Manchester.

The General Council of the **Engineers' Guild** held an evening reception on 1st February on board the *Wellington* anchored in the Thames off the Victoria Embankment, by permission of the Master and Wardens of the Honorable Company of Master Mariners. In the absence of the president (Mr. Bryan Donkin), who had been called out of the country on business, the guests were received by Mr. E. W. Greensmith, chairman of the Council and Mrs. Greensmith.

The twenty-ninth annual sports of the **Indian Cable Co., Ltd.,** were held on the company's recreation ground at Tatanagar, Bihar, India, on 8th January.

The finals of 25 track and field events took place in brilliant sunshine and were watched by thousands of spectators who thronged the banked sides of the ground and the many tents. With the blue and white flag of the Cableco Welfare Association predominating the scene, the brilliant colours of the Indian costumes made a kaleidoscopic display. Company records were produced to a standard never previously achieved, no fewer than seven records being broken during the afternoon. These were in the high jump, long jump, pole vault, putting the shot, 200 metres, 800 metres and 1,500 metres. The departmental trophy was won by the Engineering Division. After tea had been served the prizes and trophies were presented by Mrs. E. D. Johnson.

Mrs. E. D. Johnson distributing the prizes at the recent sports of the Indian Cable Co., Ltd.

Sir Ben Lockspeiser, K.C.B., F.R.S., is retiring from the post of secretary to the Committee of the Privy Council for Scientific and Industrial Research on 10th March. He is to be succeeded by **Professor H. W. Melville,** F.R.S., who is at present Mason Professor of Chemistry at the University of Birmingham. Prof. Melville will take up his new appointment in August.

Mr. E. N. Simons who writes in this issue on high permeability steel castings from the historical angle, joined the staff of Edgar Allen & Co., Ltd., in 1911. Later he became progressively publicity manager, assistant sales manager, and editor of the "Edgar Allen News" and the "Edgar Allen Magazine." During the second world war he was "lent" to the Ministry of Information for whom he wrote many articles as propaganda. He also did a good deal of similar work for the British Council.

Mr. E. N. Simons

Mr. Simons is the author of 22 books, including five novels and 17 on technical subjects. He was a personal friend of the late H. G. Wells, for whom he did some work in connection with "The Work, Wealth and Happiness of Mankind." He is a frequent broadcaster and until moving south was a member of the North Regional

Council of the B.B.C. Until recently he was a member of the Council of Aslib.

The Lord President of the Council has appointed **Prof. G. B. B. M. Sutherland,** Sc.D., F.R.S., Professor of Physics and Director of the Biophysics Research Centre in the University of Michigan to be Director of the National Physical Laboratory in succession to **Sir Edward Bullard,** Sc.D., F.R.S., who retired on 31st December last. As already announced, **Dr. R. L. Smith-Rose,** C.B.E., D.Sc., M.I.E.E., has been appointed Acting Director until Professor Sutherland takes up his new duties in September next.

The annual dinner and dance of the **I.E.E. Western Centre** will be held on 9th March at the Seabank Hotel, Porthcawl. Tickets for the dinner and dance are £1 2s 6d each and students and graduates may attend the dance only (7s 6d each). Applications for tickets should be made by 13th February to Mr. E. C. Bachelor, hon. assistant secretary, Western Centre, 15, Tredelerch Road, Rumney, Cardiff.

OBITUARY

Mr. C. P. Harrison.—The General Electric Co., Ltd., announces the death in hospital after a short illness of Mr. C. P. Harrison, manager of its Marine Department. Mr. Harrison, who was aged 54, was educated at Queen Mary's Grammar School, Walsall, and was a student apprentice at the G.E.C. Witton Engineering Works, Birmingham. After serving in the Fraser & Chalmers turbine engineering works at Erith, Kent, he returned to Witton to join the switchgear and engineering estimating department. Later, he took charge of all estimating connected with marine equipment. In 1930 he was transferred to the Marine Department at the company's head office, and from 1935 he acted as personal assistant to the manager, the late Mr. C. Wallace Saunders, and succeeded Mr. Saunders upon his retirement in 1948.

Mr. Harrison was a member of the Council of the Institute of Marine Engineers and had presented many papers to the Institution. He also served on the technical committee of Lloyd's Register of Shipping.

Sir Hubert Houldsworth, Q.C., chairman of the National Coal Board since 1951, died at his home in London on 1st February at the age of sixty-six. Sir Hubert was due to retire from office next July. Before his appointment as chairman of the Board he had been Controller-General of the Ministry of Fuel and Power since 1943.

Mr. J. B. Guild.—The death occurred in London on 28th January, after a long illness, of Mr. J. B. Guild, A.M.I.E.E., second assistant engineer in the Thames grid control centre of the Central Electricity Authority. Mr. Guild was educated at the Harris Academy, Dundee, and entered the Dundee Corporation Electricity Department in 1929. Between 1932 and 1935 he was with the North-Eastern Electric Supply Co. and then joined the Central Electricity Board as a control engineer in London.

Mr. Abraham V. Heyes, governing director of Heyes & Co., Ltd., and **Mr. Bertram E. Jones,** director and general manager of the company, have died within three days of each other. Mr. Heyes who was fifty-two years of age, was a past president of the North Western Branch and a past national president of the Association of Mining Electrical & Mechanical Engineers. Mr. Jones had been associated with Heyes & Co., for about 32 years.

Mr. R. W. L. Harris.—The death occurred on 27th January, at the age of forty-seven, of Mr. R. W. L. Harris who joined the staff of Preece, Cardew & Rider, consulting engineers, in 1950 and in April, 1953, became a junior partner.

Mr. W. H. Sharp, superintendent of the Clacton, Frinton and Southend generating station, Eastern Division, Central Electricity Authority, died on 31st January at the age of sixty-one. Mr. Sharp joined the Southend-on-Sea Corporation Electricity Department as an engineer in 1920 and had been station superintendent since 1949.

Mr. A. E. Barnwell.—The death has occurred, at the age of 73, of Mr. Albert Edward Barnwell, a director of Barnwell and Falcon, Ltd., electrical engineers, Harrogate.

Mr. H. R. C. Van de Velde.—A memorial service for the late Mr. H.R.C. Van de Velde, who until his retirement last year was senior executive of the Marconi International Marine Communication Co., Ltd., was held in Chelmsford Cathedral on 31st January. The service was conducted by the Very Reverend Eric Gordon, Provost of Chelmsford, and was attended by a large number of friends and colleagues of the late Mr. Van de Velde from the Marconi Marine company and other organizations at home and overseas.

OVERLOADING CAUSES SUPPLY FAILURES

The recent severe weather resulted in power cuts and supply failures through overloading in many parts of the country. In Liverpool, factories, offices and houses in an area of about two square miles were without electricity for more than two hours on 2nd February following an explosion and fire at a substation at Pumpfield, Vauxhall Road. Power failures occurred in Huddersfield on two successive nights and in London there were cuts lasting 30/35 minutes in a number of areas.

Power Station Strike Threat

Following a threat by electrical workers in fifteen power stations to call a 24-hour token strike in support of their wage claim, a letter has been sent to local union officials by Mr. F. Foulkes, chairman of the trade union side of the National Joint Industrial Council for the Electricity Supply Industry, given a firm direction against unofficial action. It is felt that a strike would predjudice the negotiations. Last week it was reported that men at the Barking and Woolwich stations had decided to ban overtime and that those at Croydon were working to rule.

I.E.E. South Midland Centre Dinner

About 450 members and guests attended the annual dinner of the South Midland Centre of the Institution of Electrical Engineers, held at the Grand Hotel, Birmingham, on 3rd February.

In proposing a toast to the City of Birmingham, Mr. H. S. Davidson, chairman of the Centre, made a plea for the speedy electrification of the suburban railways into the city to alleviate the severe and widely known traffic chaos and to reduce the pollution of the atmosphere. The Lord Mayor of Birmingham, Alderman A. Lummis Gibson, replied on behalf of the City and commented pointedly on the state of technical education in this country and Russia. He had visited Sverdlosk in that country recently and had been impressed by its technical college facilities, which were bigger and more advanced than those in Birmingham.

The toast to the Institution was proposed by Mr. E. M. Glayson, president of the local Chamber of Commerce. Sir George Nelson, Bt., President of the Institution, in reply, dealt also with educational matters and pledged support for the Government's decision to expand facilities for technological education in our existing universities. The Institution believed that our existing educational system was sufficiently flexible to meet the needs of the situation. To make the best use of the professional engineers, however, more technicians were needed to develop their work and the bigger technical colleges would have to serve a wider region than hitherto.

Mr. D. P. Sayers the junior vice-chairman of the Centre, proposed the health of the guests, for whom Mr. T. A. Hamilton-Baynes, the deputy-chairman of the Birmingham Justices, responded.

PARLIAMENTARY REPORT

IN the House of Commons Mr. Wade asked the President of the Board of Trade whether he had any statement to make on the progress of the tariff negotiations at Geneva between participating Governments in the General Agreement on Tariffs and Trade.

Mr. Peter Thorneycroft said that the negotiations, which had only just begun, must be conducted in confidence and no report could therefore be expected before their conclusion.

Herbert Committee Report

Announcing the publication of the report of the Committee of Inquiry into the Electricity Supply Industry, under the chairmanship of Sir Edwin Herbert, Mr. Aubrey Jones, Minister of Fuel and Power, said that the report recommended a number of changes in the organisation of the industry some of which, if approved, would require legislation. In coming to decisions regarding the recommendations he would naturally give careful consideration to the views of the industry and of all concerned.

Later, when forthcoming business was discussed, Mr. Nabarro asked the Lord Privy Seal if, in view of the importance of the first of the independent reviews of the nationalized industries, and the fact that the affairs of the nationalized electricity undertaking had not been debated in the House for two years, whether it would be possible at an early date to debate both the report and the affairs of this industry.

Mr. R. A. Butler said he was aware of the contents of the report but it would be as well for M.P.s to take a little more time to study the report before debating it. It was tied up with the study, now being urgently undertaken, with a view to finding how the House could best discuss the nationalized industries. The report, however, was a separate issue and it should be considered when members had had more time to study it.

Hire Purchase Trading

Mr. Osborne asked the Chancellor of the Exchequer if he was aware that the Central Electricity Authority had increased its hire purchase trade by over 100 per cent, and was charging only 6 per cent interest, whereas private traders charged up to 16 per cent, and if he would take steps to put the private traders on equal terms with the nationalized industry.

Sir Edward Boyle, Economic Secretary to the Treasury, said the last annual report of the Authority showed that a development of this kind took place after the withdrawal of the Hire Purchase Control Orders in July, 1954. It had, however, been checked since the restrictions imposed by the Hire Purchase Control Orders of February and July, 1955, which applied to transactions of the public boards and private traders alike. The answer to the last part of the question was that the rates of interest charged to customers were a matter for the Area Electricity Boards and other traders.

Mr. Osborne: "Is the Minister aware that the Electrical Contractors' Association formed a finance company to lower the charges made to their customers; that the scheme was passed by the Board of Trade some twelve months ago, but was stopped by the Capital Issues Committee? Does he think it is fair that nationalized industries should have facilities for hire purchase business that are better than can be offered by the trade?"

Sir E. Boyle said that questions on this nationalized industry should be put to the Minister of Fuel and Power.

Steel Supplies

Replying to several questions about the shortage of steel Mr. Thorneycroft said he was advised by the Iron and Steel Board that steel production was expected to increase over the three years 1956-58 by more than 3 million ingot tons. With this overall figure there would be substantial increases in sheet capacity. There was also a voluntary agreement to restrict exports of steel to the 1955 level, although the House should bear in mind that some exports were to United Kingdom firms abroad.

Restrictive Practices of Trades Unions

Captain Kerby asked the Minister of Labour if, in view of the fact that restrictive practices by organized employees raised different problems from those raised by restrictive practices on the part of trade associations, he would now set up a commission parallel to the Monopolies Commission to inquire into the restrictive practices of trades unions.

Mr. MacLeod replied in the negative. He said the removal of obstacles to production was one aspect of the general problem of increasing industrial productivity. The question was best dealt with by the two sides of the industries concerned.

Rural Development in Wales

In the debate on Welsh affairs, Mr. Garner Evans said the people in North Wales were pleased to see the good job being done there to provide electricity in the rural areas but he would like to see more co-operation between the Merseyside and North Wales Electricity Board and the farming community, who often had the feeling that their interests were ignored. In this part of Wales the Board worked on the block system, deciding that in a given period a certain block of territory would get electrical development, but often the scheme proved to be so rigid that one found farming communities just beyond the line on the plan being deprived of electricity. He hoped there would be closer cooperation between the Board and the agricultural executive committees.

Mr. J. Idwal Jones said that the Ffestiniog hydro-electric scheme would change the picture completely; if it materialised the area would be connected with the super-grid. He asked whether an atomic power station could be sited in North Wales; it would revolutionize the pattern of life for the people.

Mr. Roderic Bowen also asked that there should be no slowing down in rural electrification. The South Wales Electricity Board was just getting into its stride in rural areas; for almost the first time the figures were satisfactory.

Mr. Cledwyn Hughes, spoke in similar vein.

Major Gwilym Lloyd-George, Minister for Welsh Affairs, replying to the debate, discussed many points raised but did not refer to electricity.

Oil-fired Stations

Mr. Aubrey Jones informed Mr. Stan Awbery that at present 227 stations were burning coal and two oil. The latter, and the further 15 stations which by 1960 would be equipped to burn oil, were geographically well placed to receive oil supplies in bulk; in these cases, under existing agreements between the Central Electricity Authority and their oil suppliers, the difference in cost of generation as compared with coal was marginal. Most of these stations would be able to revert to coal burning in periods varying between a few days and about six weeks.

Recruitment of Scientists and Engineers

Mr. Ellis Smith asked if the Government had yet considered the Report on the Recruitment of Scientists and Engineers by the Engineering Industry prepared by the Advisory Council on Scientific Policy and what action it was intended to take, and what consultations they had had with the nationalized industries on the subject of the Report.

Mr. Bevins said the Lord President of the Council had considered the report and the Government was of course well aware of the urgent need for producing more highly qualified scientists and engineers. the Government hoped to issue a White Paper very soon setting out its plans for the development of technical education.

Financial Section

STOCKS and SHARES

BY the end of January, it still could not be said that investors were taking anything more than a tepid interest in industrial shares, despite the tempting appearance of current prices in comparison with those ruling six months earlier, and of the relatively good returns to be obtained now from the investment of capital in the industrial market. It was just over six months ago that the share price averages broke the all-time altitude record and ran straight into trouble over the intensification of the credit restriction policy and a generally more serious attitude towards the suppression of inflation. Some of the consequences are to be seen in the accompanying table of comparisons between the end-January prices of a varied group of electrical and engineering companies' shares with the highest prices quoted for them last year. The column of yields, based on last year's rates of dividend, implies that the previous tendency to discount prospects has become decidedly modified.

Ord. Share	High 1955	End Jan. 1956	Yield per cent
A.E.I.	97s 6d (r)	70s 3d	3·9
Auto. Tel.	80s	70s	4·2
Babcock & W.	98s	75s 6d	4·0
B.I.C.C.	56s 3d (r)	51s	4·9
Brush	9s 9d	7s 3d	6·8
E. K. Cole	26s	19s 6d	4·4
Crompton P.	19s 9d	14s	5·6
Crabtree	34s 6d	29s	6·9
Chloride El.	78s 6d	67s	5·2
Elec. Constr.	42s	27s 6d	6·1
English Elec.	87s 3d (r)	58s 3d	4·2
Ericsson	47s 3d	37s 6d	4·7
E.M.I.	37s	32s	4·7
Ever Ready	39s	30s 3d	5·7
G.E.C.	81s 3d (r)	58s 6d	4·8
Lancs. Dynamo	58s (r)	44s	4·5
Lucas	57s 6d	36s 3d	4·1
Parsons	10's 3d	74s 3d	2·7
Plessey	88s 6d	72s 9d	4·1
Pye	23s 9d (r)	17s 3d	3·6
Reyrolle	127s 6d	97s	3·1
S. Smith	20s 3d	12s 9d	5·5
T.C. & M.	40s 9d (r)	29s 6d	5·7
Westinghouse	110s (r)	78s 3d	4·6

Note: (r) denotes that a " rights " issue of shares was made during the year. Prices and yields have been adjusted for scrip issues where necessary.

British Electricity Stocks

Some British Government stocks plumbed last month depths not encountered since the bad days of 1931. Even then the gilt-edged market seemed doubtful about the firmness of the ground underfoot, although more was heard of the view that the present level of interest rates is as high as it can usefully be pushed. Meanwhile, it is to be noted that among the British Electricity stocks, the two 3 per cent issues have been standing at discounts of more than 20 points on the price of 100 at which they must eventually be repaid, between 1974 and 1977 in the case of the senior issue, and 1968 and 1973 in the other. Current yields are under 4 per cent, but the prospective tax-free capital profit of 25 per cent on the amount of money invested is of more particular interest to surtax payers. For present yield, the 4½ per cent British Electricity stock, redeemable 1967-69, makes the best showing, the return being 4·7 per cent at a price of 96½.

Cable & Wireless Results

Cable & Wireless (Holding) £1 shares were little altered, at about 41s, immediately after the declaration of the final dividend and results for 1955. Earnings are shown to have continued strongly upon their upward course, the net figure being some £176,000 higher at £575,000, despite a much larger tax liability. Holders of the ordinary stock, who had a 1 per cent increase in the dividend for each of the three preceding years, are however to receive the same total of 10 per cent as for 1954. They were advised at the time of the increase in the interim dividend that this should not be taken to imply a larger total; the final is now being correspondingly reduced. From now on, dividends will be payable on capital increased by the 550,000 new shares issued a month ago. Last year's balance sheet showed the Trust to be holding quoted investments with a market value of nearly £17 million, apart from interests in the Cables Investment Trust and other securities.

Globe Telegraph

Like Cable & Wireless, the Globe Telegraph & Trust advised its stockholders that, in raising the interim distribution last month, the intention was only to bring nearer to equality the two half-yearly distributions, of which the final is due next July. The rate for the year has been raised on three of the last four occasions. Also in common with Cable & Wireless, the earnings of the Trust have been showing vigorous expansion since it branched out into general investment business. At the date of the last balance sheet in June, the holdings of quoted investments standing in the books at £7½ million had a market value of more than double that figure, while unquoted stockholdings were also estimated to be worth more than the book entry of £2·4 million. Ninety five per cent of the total was represented by ordinary and deferred stocks. On these figures, the " break-up " value of the assets worked out at the equivalent of 15s per 5s ordinary share. The quotation for the latter has lately been about 10s 6d.

Overseas Electricity Companies

The recent announcement that a final liquidation payment of not less than 14s per share will be made on Cawnpore Electric ordinary in a few months' time comes as a reminder of the extent to which the scope for investing overseas in the electricity supply industry has diminished in recent years. Madras Electric shareholders are also in the position of awaiting a final liquidation payment. Elsewhere, Bagdad Light and Power has transferred its undertaking to the Iraq Government; the financial details have yet to be worked out. This leaves the field mainly to the shares of Calcutta Electric, East African Power, Perak Hydro and Nigerian Electric, of which the last-named has just announced a one-for-four scrip issue. In addition, the Canadian market has steady attractions for British investors.

Canadian Investments

Four of the principal Canadian electricity and power companies have their shares officially quoted on the London Stock Exchange. Among them, British Columbia Power common shares have a good following in this country. They have been standing at around $68 (say £13 12s per share) and show a yield of 3·1 per cent on the last rate of dividend. Interest is taken also in the common shares of Shawinigan Power, quoted at $128 to yield 2½ per cent; of Power Corporation of Canada at just over $100, yielding 3·4 per cent; and of Quebec Power at about $55, yielding close on 4 per cent. In another field, Bell Telephone Company of Canada common shares are dealt in occasionally around $92, the yield in this case being 3·9 per cent. In all these cases the effective gross yield to residents of this country may be substantially increased through the operation of double tax relief on dividends received.

March Dividends

In the matter of presenting their annual results and final dividends, few companies seem able to match the speed of English Electric and Associated Electrical Industries who, despite the complexity of their organizations, customarily have their preliminary announcements out within two months of the closing of the books. Clarke Chapman, Desoutter Bros., Hoover and Bruce Peebles are generally among those few. In March, however, begins the trickle of news which develops into the main stream during the two following months. In the cable and telephone group the Ericsson results usually appear in March, a month ahead of the main body. There is not much news as a rule from the heavy branches of electrical engineering next month, but Brush, Allen West (whose year ends in January), and Switchgear & Cowans can all be expected to make their declarations, and reports will also be due from, among others, Watford Electric and Taylor Tunnicliff, and from A. F. Bulgin, whose accounts also run to the end of January.

REPORTS and DIVIDENDS

The Westinghouse Brake & Signal Co., Ltd.—The annual meeting was held on 30th January, Capt. A.R.S. Nutting (chairman) presiding. In his circulated statement, the chairman said that the modernization and re-equipment programme of the British Transport Commission had produced many important inquiries for the signalling and colliery division, including an order for re-signalling with the Westinghouse electro-pneumatic system of the St. Pancras terminal station. This system of signalling was installed recently at the Euston terminal. Despite Continental competition, exports of Westinghouse signalling systems had expanded. Last year, this division decided to produce in England electro-pneumatic retarders.

During the year under review record orders were received by the rectifier division. Valuable and numerous orders were received for equipments for the large electrical supplies for electro-tinning and electro-galvanizing of steel. Small rectifier equipments for radio, television and telecommunication equipments, had been in great demand, and the standard rectifier units and rectification equipments found ready and steadily increasing markets. During 1956 the manufacture of new rectifiers, incorporating the most advanced techniques, would be commenced in their factories.

Dealing with research and development, Capt. Nutting said that for some years there had been increasing interest in a.c. systems for electrifying railways. This had necessitated much research and development work on signalling equipments to operate such systems. They had completed the development of five new forms of track circuit equipment, which would provide for all requirements of railways adopting an a.c. traction system.

Cable & Wireless (Holding), Ltd.—The group earnings for 1955 were £575,000, after charging £462,000 for taxation, as compared with £399,028 for 1954. The staff fund receives £35,000 and general reserve £130,000. It is proposed to pay a final dividend on the single-class £5·5 million ordinary capital of $5\frac{5}{11}$ per cent (against 7 per cent), maintaining the dividend for the year at 10 per cent. The increase in the 1955 interim dividend from 3 per cent to $4\frac{6}{11}$ per cent was made in order to reduce the margin between the interim and final payments.

Associated Engineering Holdings, Ltd.—Philip Hill, Higginson & Co. have placed at 18s 4½d per share 1,483,000 5½ per cent £1 redeemable cumulative preference shares. Application is being made to the London, Birmingham, Bradford and Glasgow Stock Exchanges for permission to deal in and for quotation for these shares. The new shares form part of an authorized total of 2,777,500 such shares of which 750,000 are already in issue.

Electrical Components, Ltd., has declared an interim dividend of 10 per cent on capital increased by a one-for-three rights issue. For the previous year the interim dividend was 7½ per cent. The increase has been made with a view to lessening the disparity between the interim and the final dividends.

New Companies

A to Z Electric, Ltd.—Registered 25th January. Capital £3,000. Electrical, radio, television and refrigeration engineers, etc. Directors: S. L. Cramer, Helen Cramer and Jane Simons. Regd. office: 374, Old Street, E.C.1.

J. W. Fazey and Sons, Ltd.—Registered 24th January. Capital £1,000. Manufacturers, repairers, servicers and hirers out of and wholesale and retail dealers in radio, electrical and mechanical apparatus of all kinds, etc. Directors: J. W. Fazey, Mrs. Ethel Fazey, J. W. Fazey, jnr., D. Fazey and S. Fazey. Regd. office: 17, Vine Place, Sunderland.

E. G. Miller & Co., Ltd.—Registered 21st January. Capital £2,000. Electrical, mechanical, general, constructional, motor, marine, radio, television and telephonic engineers, etc. Directors: E. G. Miller and D. W. Evans. Regd. office: 69a, Farnley Road, South Norwood, S.E.25.

P. Squire (Andover), Ltd.—Registered 23rd January. Capital £5,000. Electricians, etc. Directors: P. Squire, Mrs. Winifred M. Squire, and A. H. Holloway. Regd. office: 19, Bridge Street, Andover.

Perdio, Ltd. — Registered 20th January. Capital £100. Manufacturers of and dealers in electronic equipment and components, etc. Directors: A. J. Richards and D. Wilmot. Regd. office: 13, Bloomsbury Square, W.C.1.

C.M. Electrical, Ltd.—Registered 20th January. Capital £1,000. Electrical contracting and wiring, etc. Directors: C. W. Edwards, Mrs. Ivy F. Edwards and A. W. Wilson. Regd. office: 51/53, Kensal Road, North Kensington, W.10.

G. Ellam, Ltd.—Registered 20th January. Capital £100. To acquire the business of wholesale electrical suppliers and factors lately carried on by G. Ellam, Ltd, at 49, Gartside Street, Manchester. Directors: F. Hulme and G. F. Henson. Solicitors: Bernard Kuit & Co., Manchester, 3. (Reference to this company is made in our Industrial News section).

Increases of Capital

British Central Electrical Co. Ltd.—Increased by £20,000, in £1 "A" ordinary shares, beyond the registered capital of £4,500.

Acoustical Manufacturing Co., Ltd.—Increased by £7,000, in £1 redeemable 6 per cent preference shares, beyond the registered capital of £1,000.

Square D, Ltd.—Increased by £49,900, in 25,449 "A" ordinary and 24,451 "B" ordinary shares of £1, beyond the registered capital of £100.

Liquidations

Redco Electrical Co., Ltd., electrical engineers.—Winding up voluntarily. Liquidator, Mr. R. L. Davis, 58, Theobalds Road, London, W.C.1, appointed 20th January.

F.W. Cole & Sons (Manchester), Ltd., electrical contractors.—Winding up voluntarily. Liquidator, Mr. G.H. Eaves, 47, Mosley Street, Manchester, 2, appointed 24th January.

Bankruptcy

C. C. A. Bright, 5, Nestor Court, Preston Road, Brighton, formerly of Sutton, Surrey, electrician.—Public examination 9th March at the Court House, Church Street, Brighton.

International Samples Fair, Milan

A selective display of nearly five hundred British products is to be shown in the Palace of the Nations at this year's International Samples Fair, Milan (12th to 27th April). This display is being arranged by the Board of Trade, which has invited the Council of Industrial Design to choose the exhibits from its "Design Review." Categories of goods to be shown include: household equipment and kitchenware, and there will also be a small selection of lighting fittings.

TRADE MARKS

Applications have been made for the registration of the following trade marks. Objections may be entered up to 18th February:—

ROTELLAMATIC. No. 745,151. Class 7. Clothes drying machines.—Hotpoint Electric Appliance Co., Ltd., Crown House, Aldwych, London, W.C.2.

HEENATRON. No. 746,631. Class 7. Electric motors (not for land vehicles) having electronically operated control gear for giving variable speed. HEENATRON. No. 746,632. Class 12. Electric motors (for land vehicles) having electronically operated control gear for giving variable speed.—Heenan & Froude, Ltd., Worcester Engineering Works, Shrub Hill Road, Worcester.

HORNMASTER. No. B735,799. Class 9. Electrically heated searing irons for use in destroying the horn-buds of animals.—Cooper-Stewart Engineering Co., Ltd., Stewart Works, Works Road, Letchworth, Herts.

ELLIATOMATIC. No. 744,901. ELLIATOMIC. No. 744,903. Class 9. Measuring, recording, controlling or indicating apparatus and instruments which either use radio-active isotopes or have an application associated with atomic energy.—Elliott Brothers (London), Ltd., Century Works, Lewisham, London, S.E.13.

EKCO. No. 742,267. Class 11. Fluorescent and incandescent lighting installations and fittings for these goods included in Class 11.—Ekco-Ensign Electric Ltd., Preston House, 45, Essex Street, Strand, London, W.C.2.

LETTERS TO THE EDITOR

Letters should bear the writers' names and addresses, not necessarily for publication. Responsibility cannot be accepted for the opinions expressed by correspondents.

Portable Tools

I HAVE read the article by Mr. M. G. Trestrail in the 23rd December issue of the *Electrical Review* on " Portable Electric Tools." It is a very interesting article; particularly on their faults and their causes. My company have used small hand tools with great success in increasing output. There is one thing about them, however, to which I strongly object. That is the interference they cause to radio reception. I am a keen short-wave listener, particularly to the B.B.C. during the evenings. The person living opposite has a " home workshop " type of electric drill which creates so much interference that it is quite impossible to hear any programme.

He said I could " suppress " the tool and brought it across to me. To my disgust there was not room to insert anything but the smallest of midget condensers so I had to return it untouched. The arrangement now is that I ask him to stop using it if he happens to be making something when I want to listen to a special programme. I think the question of electrical noise suppression does not receive the attention it should from electrical manufacturers.

Colombo, Ceylon. D. M. GILL, A.M.I.E.E.

I WAS rather surprised at your interpretation of my article " Portable Tool Protection " published in your issue of 20th January. The comments in your editorial column give the impression that the article is concerned with protection of equipment where earth impedances are higher than normal. Although the devices mentioned do give this protection they are, in fact, designed to work on low earth impedances. I agree that solid earth connections offer security and protection and it is the purpose of these devices to ensure that the most vulnerable part of this connection, i.e. the flexible lead, is maintained sound while in use.

A further protective feature which is given only by the circuit of Fig. 5 is the prevention of dangerous voltages on the frame of the tool in the event of fault current, in even a low impedance earth path, failing to be cleared quickly by the circuit fuses. I would also agree with your remarks that the equipment should be simple and easy to maintain; these factors were indeed the first consideration in developing the circuit of Fig. 5, the components of which are the well known earth leakage trip and a simple transformer.

South Wimbledon, S.W.19. R. E. JENNINGS, A.M.I.E.E.

Can It Be Done?

IT is seldom that one can find an epitome of human outlooks expressed succinctly among the give and take of modern life. However I think we have such in the views of Mr. J. Eccles and Sir Claude Gibb at the recent British Nuclear Energy Conference. To summarize, perhaps unfairly in a few words, Mr. Eccles says "it can't be done" while Sir Claude says "we've got to do it".

Those who have known Mr Eccles in the past must surely have been surprised at any lack of confidence in the face of a tremendous task. I feel it was probably more deputy chairman speaking than Mr. Eccles. There will be little surprise at Sir Claude's approach. Perhaps these views will cause less surprise if we care to label them "nationalized electricity" and "industry".

There have been two occurrences recently which have raised the same comment in Canada. One was the news that Calder Hall was to be opened this summer. The other was the passage of the " Comet " across this continent. In each case, that comment was "How did they do it in the time?"

Having seen even more of Sir Claude's methods since I came to Canada, I would have every confidence in his assurances. If any delay arose, there would be many here who would be willing to come over and give a hand. That is, were we not too busy needling a reluctant Canadian Government into believing that Canadian industry can do far more than the Government thinks it can in the nuclear power field.

Toronto, Ontario. ROYDEN C. GOLDING, Editor, *Modern Power & Engineering.*

Metering kVA Demand

YOUR article entitled "Metering kVA Demand", in the issue of 20th January, reports my description of a new type of meter for the assessment of kVA demand. There is an unfortunate error in this report which alters completely the importance of the new meter. Reference is made to an error range of ± 5 per cent which should read ± 1·5 per cent. As described in the paper the overall performance of the meter is similar to that associated with energy meters, is unaffected by system power factor, and its calibration curve is within the limits allowed by B.S. 89 for commercial meters.

Trafford Park P. BAXTER. (Metropolitan-Vickers Electrical Co., Ltd.)

Control System Tachogenerators

VARIOUS types of tachogenerators were surveyed by Mr. L.J. Jones in a paper delivered on 7th February before the London Graduates' and Students' Section of the Institution of Electrical Engineers. A signal related to the angular velocity of a revolving body, in order to obtain the required performance and stability of an automatic control system, the author said, was often provided by the electrical output of a tachogenerator. D.c. tachogenerators, which were either self- or separately-excited, were more readily adaptable to control applications than a.c. types, but those required for analytical oscillography should have the minimum amount of ripple imposed on the output.

A.c. tachogenerators were available with three types of output, namely, amplitude- and frequency-modulated as functions of speed, amplitude-modulated at constant frequency, and frequency-modulated at constant amplitude. The first required a rectified output; only the induction tachogenerator met requirements of the second. The third was limited in application but enabled angular velocities to be measured with great accuracy. Many tachogenerators listed by makers as d.c. machines were a.c. types incorporating rectifiers.

Progress in Manufacture

Activities of Bruce Peebles & Co., Ltd., in 1955

THE year 1955 was a busy one for Bruce Peebles & Co., Ltd., production facilities being fully occupied with continuing demands for large rotating plant, transformers, motors and rectifiers. Important contracts were carried out for generating plant in sizes up to 25 MVA, and power transformers up to 150 MVA, and for a wide variety of rotating and static electrical plant for industrial electrification and electricity distribution.

A great deal of research was undertaken especially with regard to insulation and extra high voltage power transformer developments, and manufacturing facilities were augmented by new equipment. A programme of expansion involved an important extension to the welding department, and the now completed large extension to the testing bay of the transformer department will meet present and future test requirements of heavy rotating and static electrical plant.

Synchronous condensers completed during the year included two 16,380 kVA machines for the Northfield power station of the Electricity Trust of South Australia. Hydro-electric generators dispatched included the first of two 13,333 kVA vertical sets for the Glascarnoch power station of the North of Scotland Hydro-Electric Board and numerous induction generators for various schemes in the Scottish Highlands. The large amount of hydro-electric plant commissioned at home and overseas included a 2,400 kW induction generator in the underground Mullardoch power station and equipments up to 4,000 kVA in Norway, New Zealand, British Guiana, Malaya, Kenya, Tanganyika, South Africa, and the British West Indies.

Conspicuous among new orders received for hydro-electric plant were a 20 MVA generator for the Orrin scheme of the Scottish Hydro Board and a 11,111 kVA generator for Dolgarrog power station, North Wales.

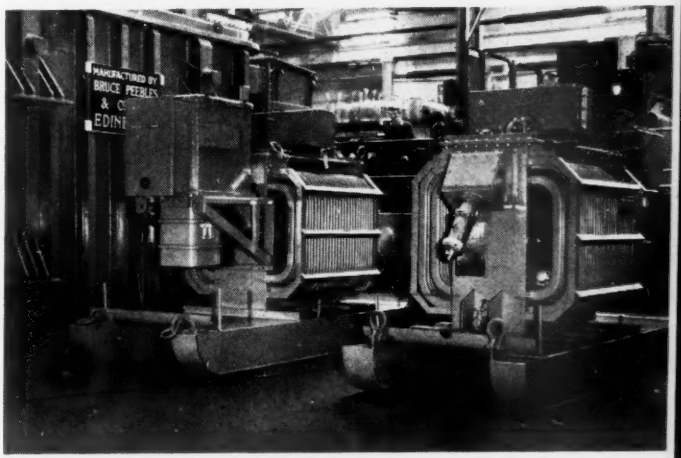
Orders for gas turbine driven generators for both home and abroad showed an increase over 1954. A 2,445 kVA generator is in course of manufacture for the peat burning gas turbine plant to be installed at Altnabreac, Caithness, and among other gas turbine-driven generators completed or on order are machines for Venezuela, Western Australia, Gibraltar and Pakistan. Two 3,333 kVA geared steam turbine driven generators are to be built for Cradoch Municipality in South Africa and orders for other similar machines for home and overseas were well up to the level of the previous year. Numbers of diesel engine driven generators were ordered, including twenty-six of 150 kVA each for the supply of power to the auxiliary plant to be installed in the world's first full-scale breeder reactor atomic power station being erected at Dounreay, Caithness.

Orders were received during 1955 for large numbers of flameproof motors for operating in coal mines. The expansion of the world oil industry has created fresh demands for flameproof motors, especially for oil refinery duty, and motors in sizes up to 500 h.p. have been ordered for widespread destinations.

The company has extended its range of tube cooled motors to include larger horse-powers and numbers were ordered for a variety of industrial services. Power factor correction schemes continue to increase for the larger industrial drives and synchronous induction motors are becoming increasingly popular. Numbers of low speed machines of this type were supplied or are on order in sizes up to 2,250 h.p. for home and overseas. The growing interest in large high speed squirrel cage motors for direct starting is reflected in the number of orders received during the year for motors up to and over 2,000 h.p., principally for driving boiler feed pumps in power stations. Outstanding amongst large low speed squirrel cage motors for direct starting are 950 h.p. and 700 h.p. machines supplied for driving mine fans.

Considerable deliveries were made of all sizes of trans-

2,400 kW induction generator in the underground Mullardoch station of the North of Scotland Hydro-Electric Board. The turbine is vertical, coupling being by encased gearing



400 kVA transformers for service in open cast coal mining, complete with switchgear and runner plates

formers from a few kVA up to 45 MVA for voltages up to 132 kV. At present, emphasis is on large units for extra high voltage service. Four 120 MVA auto-transformers with on-load tap changing switchgear are being built which will be used to link the 132 kV grid with the Scottish end of the new 275 kV supergrid, and a 150 MVA 15/295 kV generator transformer for connecting a 120 MW generator to the 275 kV grid has been ordered for the new power station at Kincardine-on-Forth. Other orders in hand for the nationalized electricity supply industry for transformers of all types run into well over a million kVA. Outstanding additional orders have been placed with the company by the National Coal Board for transformers from 5 kVA up to 5,000 kVA including many mobile units for use underground. Many transformers ordered are for export, and several hermetically sealed transformers are for oil installations in the Middle East and for Venezuela where under-water drilling is being worked on a large scale. Of more than ordinary interest is the order received for a number of Pyroclor-filled transformers for India designed for operating in an acid and hydrogen sulphide atmosphere.

Insulating Coating

A MAJOR requirement in the electronic industry is for a simple method of applying a reliable insulating layer over intricately shaped components for use under conditions varying from tropical heat and humidity to arctic cold. Some of the disadvantages of existing methods are given here and a method developed by Bakelite, Ltd., to overcome these difficulties is described.

The use of a potting system means that production is slow and costly because of the long curing cycle necessary. Irregular thicknesses of insulant may cause cracking both during curing, due to uneven shrinkage, and during use, because of the release of residual strain by temperature and humidity variation. Components containing large metal sections or heavy windings cannot be potted successfully because of volumetric shrinkage differences between metal and insulant which result in cracking and lack of adhesion. Cold curing, which is usually necessary, may be inhibited by metallic sections of the components.

Tape winding followed by impregnation is a lengthy operation which often has to be done by hand. When complicated shapes are involved a close and intimate contact without air inclusion is often impossible and the risk of breakdown is therefore severe. No visual check on the completeness of protection is possible. When dipping in impregnating varnish several repetitions of the process are necessary and long drying or curing periods are usually required. Wax coatings, which are obviously unsuitable for components working at high temperatures, also show a tendency to cracking under cold conditions.

The dip coating process using Bakelite polyester resins can be used to give rapid production and is easily adapted for use with almost all types of components irrespective of shape or size. A short preheat and a hot curing cycle combine to eliminate inhibition of cure from moisture or chemical action, which might otherwise cause planes of poor insulation and lack of adhesion, and the transparency of the insulating coating makes visual inspection easy, and allows identification labels or colour coding to be incorporated. Because the insulant is applied as a uniform coating the mechanical strength of the finished component is not impaired by stress lines over varying sections.

The mix is made up as follows: Bakelite thixotropic polyester resin SR.18903, 600 parts by weight; Bakelite polyester resin SR.17438, 200 parts by weight; and Bakelite catalyst Q.17446/1, 32 parts by weight. The polyester resins are thoroughly mixed together before the addition of the catalyst, which must be completely dispersed in the mixture, preferably by mechanical stirring.

Components to be treated are preheated at approximately 100 deg C for a sufficient length of time to ensure even heating throughout and to drive off moisture. Any components containing phenolic resin bonded sections require the preheat temperature to be at least 130 deg C to remove free phenol. The mix formulated above should have a pot life of at least 24 hours at room temperature.

The preheated components are immersed while still hot in the resin mixture and withdrawn slowly to break air bubbles. For components of intricate shape a withdrawal rate of one inch in five seconds gives an excellent coating with high dielectric strength; for simple components the withdrawal rate may be increased.

After removal from the resin mixture the coating is allowed time to gel and the component is then redipped. Identification labels, if required, can be incorporated with the first coat before gelation. After the second dip the components are returned to the preheat oven for curing. Curing times depend on the thickness of coating applied, the amount of catalyst used and the temperature: when using the amount of catalyst quoted above, five minutes at 100 deg C will usually be adequate. Two dips will give a coating of $\frac{1}{32}$ in approximately and coatings of this thickness, cured for five minutes at 110 deg C have shown breakdown voltage figures greater than 10 kV.

Electricity in the Low Countries

THE tenth Caroline Haslett lecture was given by Miss Mary Mitchell, senior demonstrator of the St. Pancras District, London Electricity Board, at the Institution of Electrical Engineers on 31st January. Miss Mitchell, who visited Belgium, Holland, Denmark and Luxembourg, made a study of electrical education, publicity and large scale equipment.

She said that in Belgium, the company based on Malines sold cookers to schools at half price and serviced them at cost prices of materials only, and every school in the area had at least one electric cooker. Elsewhere there were specially low tariffs for schools and colleges. In Holland domestic science was well established, while in Denmark the North Zealand Supply Co., supplied free a standard set of electrical equipment upon request by any school.

In Belgium and Holland, domestic science training was designed for teachers. In Holland, the training included some months in an institution with large scale equipment, both for cooking and laundry.

Of the countries visited, Belgium had the most highly organized electrical propaganda system. The Belgian supply authorities had agreed to operate a national tariff, publicity for which began about a year ago. There were four sections to the tariff, designed for low, medium and large consumption, with a night tariff for water heating and cattle feed boilers. National advertising was directed by the U.E.E.B. backed by the supply companies using the methods most suitable to their localities. There had been an increase in the domestic load of 8 per cent since the campaign began. The U.E.E.B. had prepared propaganda for architects the theme of which was "Look to the future; do not put in minimum installations".

The headquarters of the electrical industry in Holland, so far as managerial, technical and testing matters were concerned was K.E.M.A., but publicity was left to the companies. Denmark had an organization known as E.L.R.A., which was being built up as the national information and advertising centre, along the lines of E.D.A.

Miss Mitchell spoke of her visits to kitchens and laundries where large scale equipment was employed and showed how national diets influenced the design of kitchen equipment.

Electric Traction at Power Frequency

THE ECONOMICS OF RAILWAY ELECTRIFICATION

TECHNICAL and economic aspects of railway electrification by a.c. at 50 c/s provided the subject of an integrating paper given by Messrs E.L.E. Wheatcroft and H.H.C. Barton (Merz & McLellan) before the Utilization Section of the Institution of Electrical Engineers on 2nd February. The authors submitted that while d.c. (which was in use on two-thirds of the world's electrified route mileage) met the requirements of suburban traffic, the 50 c/s single-phase system was likely to be cheaper for new main line projects and offered no technical difficulties.

The series-wound d.c. motor, it was pointed out, because of commutation-voltage limitations had to operate at a maximum of 3 kV. This necessitated larger conductors and more numerous substations than were needed by an a.c. system which incorporated transformers on the rolling stock and used a higher line voltage. Particulars were given of earlier a.c. systems at 16⅔ c/s and of the 50 c/s motors now available. The latter might entail more problems of maintenance and unsprung weight if axle-mounted, but costs of fixed equipment with the use of industrial frequency would be greatly reduced.

Of the basic types of conversion now in operation, viz, a.c. motored, motor generators with d.c. or induction motors and rectifiers with d.c. motors, the third was held to provide the best all-round answer. It enabled the well-proven d.c. traction motor to be adopted and offered scope for dual-system operation when extending main line electrification which already embraced a d.c. section.

Service experience had been mostly with the single-anode ignition rectifier, but British and French railways had experimented successfully with the simpler air-cooled "excitron." The application of semi-conductor rectifiers was not far distant with consequent simplification of equipment and savings in space—possibly in weight coupled with rigid construction.

Substation spacing was largely affected by tolerable voltage drop at the trains; this should be not more than 20 per cent normally but could be 50 per cent for limited periods under abnormal conditions in order to keep trains moving without shutting down brake exhausters or compressors. Since voltage drop on a.c. systems was due mainly to reactance, the conductor size might be a minimum required for mechanical reasons. For the same substation spacing at 50 c/s the greater reactance would necessitate raising the voltage to about 25 kV from the 15 kV generally found suitable at 16⅔ c/s on the Continent.

Because of the peaky nature of its demand, any traction load was tolerable to a general supply system only if small compared with other loads or if supplied through feeders of low impedance. In that case the system could cope with phase unbalance and harmonics due to rectifiers. Power factor of rectifier locomotives was between 0·80 and 0·92, which would become from 0·7 to 0·8 on the supply to the traction substations.

For balancing the three phases a method adopted in France was to install a three- to two-phase Scott-connected transformer in each intermediate substation, where line equipment was sectioned, the two directions being fed from different secondary windings. This arrangement gave an approximate balance on sections carrying dense traffic. Another method was to sectionalize the overhead line equipment into three, six or nine parts, approximately equal in average loading, as shown in Fig. 1, the Scott connection being replaced by an open-V connection.

COMPARATIVE ANNUAL COSTS OF 300-ROUTE-MILE PROJECT

	1,500 V d.c.	3,000 V d.c.	16⅔ c/s a.c.	50 c/s a.c.
Power	11·5	11·4	11·7	11·8
Operation	22·8	22·9	24·4	22·5
Maintenance	20·2	18·8	18·1	17·5
Total (running)	43·0	41·7	42·5	40·0
Interest	61·5	48·7	41·7	39·4
Depreciation	12·0	10·2	9·1	8·8
Total (interest and depreciation)	73·5	58·9	50·8	48·2
Grand totals	128	112	105	100

With the higher line voltage practicable with a.c., conductors of smaller cross section could be used than the 0·3 sq in of copper commonly used with d.c. in Britain. Considerations of wear made 0·166 sq in advisable as a minimum with a.c. Additional savings were possible

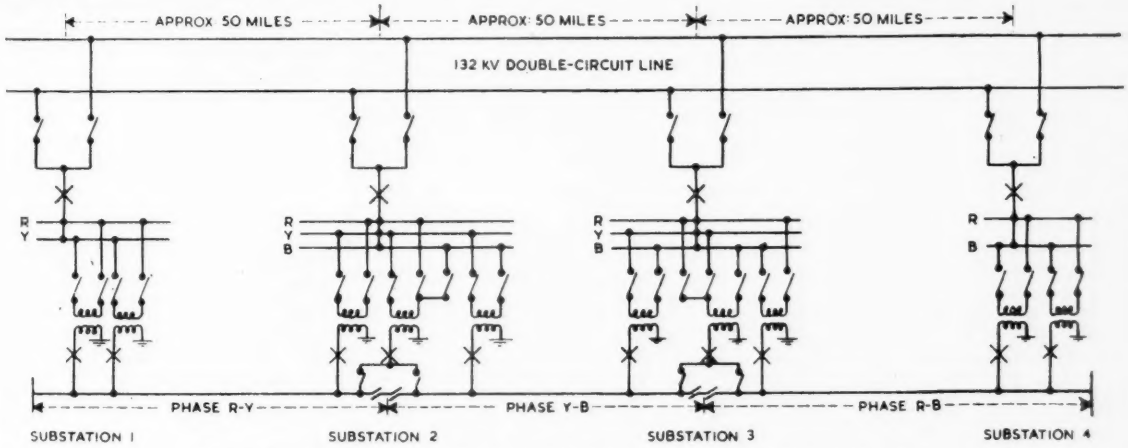


Fig. 1.—Double-end feed arrangement for supplying three sections of line from four substations

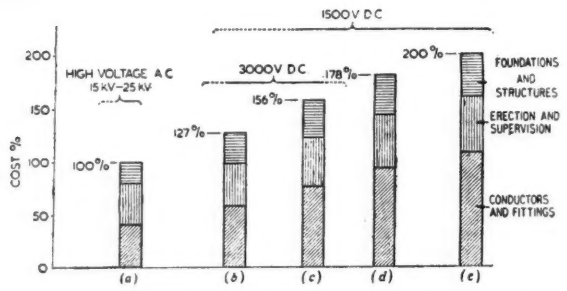


Fig. 2.—Component costs for different conductor cross-sections

	Cross-sectional area	Equiv. copper section	Catenary	Auxiliary catenary	Contact wire
			Hard-drawn copper	Hard-drawn copper	Cadmium copper
	sq in	sq in	in (dia.)	in (dia.)	sq in
(a)	0·24	0·21	7/0·116	—	0·166
(b)	0·50	0·45	19/0·116	—	0·30
(c)	0·69	0·63	37/0·101	19/0·080	0·30
(d)	0·87	0·81	37/0·116	19/0·109	0·30
(e)	1·07	1·00	37/0·136	19/0·124	0·30

because of the lighter structures and cheaper foundations as indicated in Fig. 2. Line-work clearances for 50 c/s projects were tabulated as a result of experience in various existing schemes; the cost of alterations entailed varied widely with the topography of the route.

Interference with open-wire telecommunication circuits running parallel to and near track conductors was appreciably higher with a.c. at power frequency, but most of the associated problems would disappear with the substitution of screened cables for open wires, which often formed part of betterment plans of railway and Post Office engineers. Electrification project studies by the authors, which included provision for new signalling installations as well as conversion of existing ones, showed that the cost of this work was not markedly affected by differences in traction systems.

The comparison of annual costs of four systems for a 300 route-mile project with low traffic density given in the accompanying table revealed that the difference lay mainly in capital charges, and that in this instance the standard frequency system was cheaper by 12 per cent than 3 kV d.c. at 3 kV and by 28 per cent than 1·5 kV d.c. These results arose almost entirely from differences in capital expenditure in track equipment and substations (comprising half the total) which was 50 per cent more for d.c. than for a.c. The a.c. alternative was more expensive (by 12 per cent) only for alterations to ways and works. The a.c. system seemed likely to be cheapest for lines of high traffic density also.

As compared with diesel operation, one investigation by the authors indicated that costs balanced at about eight million trailing ton-miles per annum per single track mile; another investigation showed about half that amount, high traffic density favouring electrification. In both cases the figures with d.c. would have been much higher.

Electrical Housecraft Advisers' Conference

THE annual conference of electrical housecraft advisers and senior demonstrators, organized by the British Electrical Development Association and the Electrical Association for Women, which was held in London from Tuesday to Friday last week, was attended by 400 women in the electricity supply industry from all parts of the country, as well as visitors from Northern Ireland, the Channel Islands and France. The emphasis this year was on good baking craft and good salesmanship.

At the opening session on Tuesday, Mr. J. I. Bernard (E.D.A.) presided, and was supported by Miss V. Norvick (E.A.W.). The opening address was given by Mr. D. Bellamy, deputy chairman of the E.D.A. Council and chairman of the Yorkshire Electricity Board, who said that the domestic load and the housecraft adviser's work was of major importance today. The cost of putting electricity into housing estates was a very serious and different proposition from that prevailing before the war. The average cost then was £19 per house, while to-day it was £50. If we were to get a reasonable return on outlay we must have development. The development of the domestic load meant that electricity could be supplied more cheaply, but we must have a balanced load with extended domestic development in order to preserve the price balance and price levels that existed today. During the past few years Government Committees had been appointed to determine the real economics of the utilization of fuel, and these had shown the price at which electricity must be provided to compete with other commodities at present prices. The additional cost of electrical equipment over alternative sources of heat and energy was not a great deal spread over a few years, and it provided the advantages of cleanliness, elasticity and ease of operation. After the Electricity Boards had provided all the facilities in the way of hiring schemes, it was the demonstrators' business to get the appliances into the home and keep them there.

Following Mr. Bellamy's address, Miss Norvick presented the Elizabeth Sloan Chesser Cup to Miss Roper.

Miss F. F. Laidler, principal of Battersea Training College of Domestic Science, in presenting a paper on "Home Economics, Present and Future", said that home economics today meant three things. First, the teaching of the basic skills; secondly, the inculcation of knowledge of how to use leisure time in order to beautify the home, and thirdly to open up avenues of thought so that the home economist was a person of resource as well as being well informed. The essential duties of the adviser and demonstrator were to nourish their own minds, to become skilled craftesmen, to foster judgment of quality concerned with some of the intangible things as well as the more obvious, and above all, to develop the power of independent thought. She foresaw that in the future electricity would be more and more used, which would require more and more teaching of its use.

In the afternoon Mr. J. J. Devlin, principal bakery officer, British Baking Industries Research Association, gave a talk on good baking entitled "The Four Foundations of Good Baking," in which he covered such matters as suitable materials, balanced recipes, correct mixing method and correct baking conditions. In the evening the delegates went to the Institution of Electrical Engineers for the Caroline Haslett Trust Lecture given by Miss Mary Mitchell.

Wednesday's proceedings were presided over by Commander Thompson, R.N. (Retd.), chairman of the South Eastern Electricity Consultative Council, and the first speaker was Mr. J.A. Stedman (E.D.A.), whose paper "Salesmanship—Principles and Training Methods" provoked a good deal of discussion. The next speaker was Mrs. Marguerite Patten (B.B.C. Television), whose address on "Selling Electrical Appliances" dealt with the various types of customers with their home needs of to-day. The session was concluded with the showing of some E.D.A. films.

On Thursday the delegates visited the Hotel and Catering Exhibition at Olympia where, after Mr. E. M. Ackery (E.D.A.) had pointed out the electrical highlights of the exhibition, they were able to make a tour of the stands.

The concluding day was spent at the Connaught Rooms where, as is customary, the delegates were able to air their views on what they had heard during the week, and the conference ended with a luncheon.

'New Lamps for Old'

Can Fluorescent Tubes be Reconditioned?

By G. V. McNEILL, Graduate I.E.E.*

THE magician in the "Thousand and One Nights" offered new lamps for old. A modern version is the invitation to users to have their old fluorescent tubes "reconditioned." There was, of course, a catch in the magician's offer, and since to my knowledge there are no "magic" fluorescent tubes in existence we should examine the "new lamps for old" proposal more closely.

The question we must first consider is: "How does a fluorescent tube reach the end of its useful life?" Most people are aware that an incandescent filament lamp fails when the filament breaks and thus ceases to emit light. A fluorescent tube, however, may have to be replaced for less obvious reasons. The most important factors adversely affecting tube performance and making eventual tube replacement necessary are unstable electrical operation, due to the de-activation of the oxide coated filaments (cathodes) and reduced light output caused by chemical deterioration of the internal phosphor coating. In order to understand the relative importance of these factors it will be useful to review, very briefly, the fundamental principles by which the fluorescent tube produces light.

A clear glass tube is internally coated with a fine layer of specially prepared phosphors which have the property of being able to absorb the invisible ultra-violet energy emitted by the mercury arc and to transmit this energy as visible light. Coiled-coil tungsten filaments are sealed into each end of the glass tube which is filled with a mixture of argon gas and mercury at low pressure.

The filaments, or cathodes, are coated with alkaline earth oxides which emit electrons freely when heated. Every time the arc is struck, portions of the oxide coatings are sputtered away on to the adjacent glass tube. In addition to this intermittent loss of oxides with every starting operation there is a continuous erosion of the oxide coatings throughout the running period by ionic bombardment from the arc. The time will therefore arrive, dependent on the number of starts and the hours of operation, when the cathodes will become completely denuded of the electron emissive oxides and thus fail to emit the electrons necessary to maintain a stable arc. This is the most common reason why a tube has to be replaced.

Throughout the running period there is a gradual decline in the efficiency with which the phosphors transform the ultra-violet energy into light. One of the main objects of research in fluorescent lighting has been to produce a tube which has a high initial light output (lumens) and also maintains a high efficiency throughout its life. The success of the scientists in dealing with this problem is not always realized, since it has been due to a large number of small improvements. The comparison of costs in Table 1 in 1941 and 1955 shows that, for an equal number of light-hours, the cost of the new tube is only about one-twelfth of what it was fifteen years ago, even allowing for the introduction of purchase tax in the meantime.

TABLE 1.—Comparison of Tube Replacement Costs in 1941 and 1955

Year	Rated Life of Tube (Hours)	Average through Life Light Output (Lumens)	Cost of Tube (5' 80 W)	Lumen-Hours per Penny of Tube Cost
1941	2,000	2,160	32s 6d	9,860
1955	5,000	4,160	15s 8d*	111,000

* This price includes 2s 8d purchase tax. (No tax on tubes in 1941.)

Now that we have examined the factors affecting tube performance we can see that in order to use a fluorescent tube beyond its normal life it is necessary to re-coat the cathodes with active materials (to enable the arc to strike) and, if possible, to improve the light output efficiency of the phosphors.

It is possible with a small proportion of "failed" tubes to obtain a few extra hours of life by purely electrical methods. This temporary improvement can be made without access to the inside of the tube and, therefore, the cost of reconditioning should be quite low. The life of such a tube will be extremely short, whereas the method about to be described will give a more positive increase in life since the emissive oxides are actually restored to the cathodes.

When a tube has failed because of complete de-activation of the oxide coatings it is possible to cut holes in the glass tube opposite each cathode and recoat the filaments with fresh oxides. The tube is then baked so as to drive

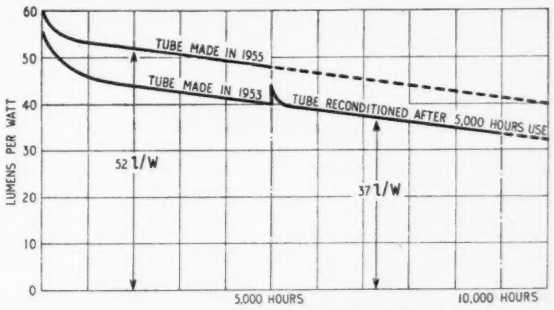


Fig. 1.—Lumen-maintenance curves for 5ft 80 W "Warm White" tubes made in 1953 and 1955

off some of the contaminating mercury, and other impurities, from the phosphor coating. The tube is sealed and re-pumped and the argon gas and mercury filling is renewed. This will cause an increase in the light output which may last several hundred hours before it returns to its previous value (see lower curve in Fig. 1). The process, however, is by no means as simple as it sounds and does not allow the degree of quality control required for the production of reliable tubes of consistent quality.

A third factor that makes the reconditioning of tubes uneconomical (even assuming that a 5,000-hour second life is achieved, which is unlikely) is the continuous progress that is being made in the quality of fluorescent tube production. The importance of this factor, which has already been discussed, will be more clearly understood from the following typical example.

Let us consider an installation in which the lighting is being used for fifty hours a week (2,500 hours a year).

* Thorn Electrical Industries, Ltd.

The tubes being considered for reconditioning, therefore, will be about two years old. In the foregoing lumen-maintenance diagram (Fig. 1) the lower curve shows the lumen efficiency values for a tube made in 1953, and reconditioned after 5,000 hours' use, whilst the upper curve applies to a tube from current production.

Assuming that we allow the best possible results for the reconditioned tube, i.e. a 5,000-hour second life and an improvement of 4 lumens/W in the " initial " efficiency, it can be seen from Fig. 1 that the average-through-life efficiency of the reconditioned tube is only 37 lumens/W as against 52/lumens/W for the new " Warm White " tube. Since both tubes consume 80 W (plus 14 W control gear loss) throughout a life of 5,000 hours we can calculate the combined " electricity plus tube " cost required to provide a given quantity of light for a given number of hours, for instance, per million lumen-hour output. Table 2 compares these costs for the two tubes and shows quite clearly that, to enable the user to get equal value, the reconditioned tube should not only be supplied free of charge but should also include a bonus of more than 5s to cover the additional expense incurred.

In conclusion, it should be noted that the example in the table has been calculated assuming the best conditions for the reconditioned tube. A further bonus allowance should, of course, be made to compensate for the second-hand appearance of the old tubes and to cover the additional packing and transit costs incurred when returning the tubes for reconditioning. Surely, no further comment is needed to show why the large manufacturers of branded tubes do not offer " new lamps for old."

TABLE 2.—Comparison of Costs of New and Reconditioned 5ft 80 W " Warm White " Tubes

Date	New Tube	Tube reconditioned after 5,000 hours' use
Tube life in hours	5,000	5,000*
Lumens/watt efficiency ... (Average through life value)	52	37
Million lumen-hr. per tube	20·8	14·8
Electrical energy cost per 5,000 hours' use ... ... (Cost in pence, allowing 94 W per tube and 1½d/kWh)	705d	705d
Cost of electricity per million lumen-hr.	2s 10d	3s 11½d
Cost of tube, incl. p. tax ...	15s 8d	7s 6d
Tube cost per million lumen-hr.	9d	6d
Total electricity plus tube cost per million lumen-hr.	3s 7d	4s 5½d
Difference in total cost per million lumen-hr.... ...	—	10½d
Difference in total cost per tube	—	13s 0d

* Although a second life of 5,000 hours has been allowed it is extremely doubtful whether any " reconditioned " tube will give much more than 1,000 hours' extra life

Television in the Service of Science

THE 7th memorial lecture of the Television Society commemorating the life and work of Sir Ambrose Fleming, the inventor of the radio valve, was delivered at the Royal Institution on 19th January by Prof. J. D. McGee of Imperial College. Prof. McGee, who is well-known for his pioneer work in the development of the Iconoscope, chose for his subject " Television in the Service of Science " and considered in detail the possible extension of television techniques for scientific purposes into the infra-red, ultra-violet and X-ray ranges of the spectrum.

Considering the infra-red radiation, two types of television microscope were described. The first used a conventional light source and television camera tube, while the second microscope used a flying spot scanner, photo-multiplier and a display cathode-ray tube.

Conventional ultra-violet microscopes covering the range 2,000 Angstom units to 4,000 Angstom units have been designed and used, but they have the limitation that the operator cannot observe what is happening to the specimen. Television techniques using an ultra-violet sensitive photo-cathode together with a quartz window can overcome this defect. This technique has great possibilities in the biological field and in particular for cancer research. Unfortunately however, important though this field is, there are no such camera tubes available commercially at the moment.

Radiologists employ X-ray techniques in their investigations and diagnoses in the medical field. However, with present practice, observations can only be made under dark adapted eye conditions, and it is known that under such conditions the eye looses acuity. This loss of acuity can be overcome by using an X-ray sensitive camera tube, operating on the photo-conductive principle. Existing image intensifier fluoroscope techniques could be extended by replacing the small viewing screen with a storage surface and and scanning this in the normal manner to produce a television signal. For the observation of any rapid movement, the lag normally associated with photo-conductive surfaces would have to be overcome.

The detection of gamma-rays which are of even shorter wavelength than X-rays is at present being achieved by a phosphor/photo-multiplier combination. The quantum efficiency is however exceedingly low and the storage principle could be of great use. A further application of television camera tubes is in the detection of faint optical images, for example as are encountered in astronomy and astro-physics.

The greater quantum efficiency of the photo-electric effect, which can reach 20 per cent would help considerably in astronomy. In addition, it is known that the reciprocity law holds down to very low light levels; a wide range of wavelengths can be covered; electronic presentation is possible; the signal to noise ratio is improved; and the sky background can be removed electronically. All these factors of the photo-electric effect could be useful in extending the range of the existing 200in Hale telescope such that it would be possible to record stars whose brightnesses are three magnitudes smaller than those observed at present. This would mean that light would be observed from stars which had taken 5000 million years to reach the earth, and this time duration is believed to correspond approximately to the age of our universe.

In conclusion, Prof. McGee outlined the requirement of a television camera tube which could effect this improvement in astronomy. The main properties of this tube would be:— good quantum efficiency, good linear integration, the target surface to be highly insulating, good reproducability of pictures, and the rejection of the background signal. While a tube to these specification details has not yet been developed there would appear to be no fundamental reason why this could not be done.

High Permeability Steel Castings

An Historical Note

By E. N. SIMONS

MANY small castings used for the manufacture of electrical machinery in the early days were made of forged wrought iron because it was impossible to obtain steel castings that would possess the required properties. The only processes available were the crucible, the Siemens Martin, and the Bessemer convertor, all three of which had limitations that prevented their use on an extensive scale for the making of high permeability steel castings. The crucible process did not produce a suitable quality of material and had only a small output. The Siemens Martin steel was too high in carbon and not fluid enough for light sections, and the Bessemer process produced a steel with too high a percentage of impurities.

In the first few weeks of 1891, Alexandre Tropenas, a French foundry engineer and metallurgist, was invited by Edgar Allen & Co., Ltd., of Sheffield, then a small firm only just converted from a one-man business into a private company, to put down a small convertor at their Tinsley works, recently acquired, at his own cost, they supplying him with the blast " and materials to be blasted," as Robert Woodward, a director of the new company, put it in a letter to his chairman. If the process was a success, the firm was entitled to take over the apparatus at cost price and take out a licence from him. The Tropenas process was an improvement upon the Bessemer convertor process, the blast being directed at an angle on to the surface of the molten bath instead of up through the bottom of the vessel, as in the Bessemer.

The process was a great success, and on 30th August, 1892, Woodward wrote to Edgar Allen: " Special steel magnet castings—We are now making these to take the place of wrought iron forgings in dynamos . . . . For your private information, this last lot analyses 0·14 carbon with only a trace of manganese. The presence of the latter, we understand, is fatal to good dynamos."

On 22nd October, 1892, the forecast was made that " this will be a big and profitable trade . . . our material is not ' steel ' but pure iron or nearly so. Our castings are a decided success for this purpose and are what the electricians (*sic*) are on the look out for." One name suggested for the new material was " Metallic Castings for Dynamos," prefaced by the firm's Imperial mark, and another was " Metallic Dynamo Castings," but in the end they were known as " Dynamo Magnet Steel Castings."

On 8th November, Woodward wrote to Tropenas asking: " What are the elements which retard the flow of electricity? Carbon and manganese, we know, are objectionable. What others? When you were here, you spoke of exercising much care in annealing castings. Do you know whether the conductivity is the same in a casting (or forging) not annealed as in one annealed?"

The revelation that high permeability magnet castings could be successfully made by a steel-making process soon penetrated to the Continent, and early in 1893 it became evident that Krupp was actively pushing similar castings with the following composition: Carbon 0·240, silicon 0·220, sulphur 0·044, phosphorus 0·037, manganese 0·240, aluminium, a trace. Meantime, the British business in these castings was developing very satisfactorily. Johnson & Phillips, of London, were numbered among the earliest users, having had nearly six tons by 24th February, 1893, with a further three tons on order. The steel was much purer than Krupps made for this purpose, and therefore, it was believed, much superior in electrical efficiency and permeability.

Other early purchasers of the company's dynamo magnet steel castings included Mather & Platt, Ltd., of Manchester, and Siemens Bros., of London. It had been established by actual performance that the castings were more regular in quality than iron and could be cast nearer to shape than iron could be forged. (The difference between a forging and a casting was not merely one of actual wages paid for machining the forging.)

By May, 1893, Mavor & Coulson and Manchester Edison Swan Co. had joined the list of users. The prices varied, of course, with the weight and intricacy of the castings, ranging from 40s a cwt in one instance to 17s in others. According to the available records, the largest castings supplied at that period weighed 22 cwt, and the smallest, ¾ cwt.

The need for accurate information regarding the characteristics of the material had previously been appreciated, and as early as 22nd December, 1892, the firm had sent samples to Gisbert Kapp, of 31, Parliament Street, London, S.W., asking him for information as to the value of this special material as compared with iron forgings. Further samples were sent to Mr. Kapp for test in June, 1893, and the firm made it clear that they had " no wish to claim for our material a higher value than it is really worth: on the other hand, we wish to be in a position to assert its full value for dynamo magnets, and also to improve it if possible." Kapp's first tests enabled him to certify that the steel efficiently took the place of wrought iron for dynamo magnets.

The percentage composition of the steel at this date was as follows: Carbon 0·120, silicon 0·065, sulphur 0·034, phosphorus 0·066, manganese 0·072. In July of the same year, Woodward's attention was arrested by an article in *The Electrician* entitled " The Magnetic Curve Tracer," written by Professor Ewing, and sought to get into touch with him, in the hope of obtaining genuinely accurate data regarding what electrical engineers really desired. He wrote privately to A. P. Trotter, editor of *The Electrician*, on the following lines: —

" It seems to me you are rather rough on the iron and steel manufacturers. You expect them to be electricians as well as what they are—and that isn't much! We have experienced the greatest difficulty in getting information of a definite kind from dynamo makers. We have always understood that manganese as well as carbon affects adversely the permeability of a dynamo magnet; but one of the most experienced and successful makers of dynamos told us a few weeks ago that it was now thought the presence of manganese rather improved the permeability of the magnet than otherwise. If we propose to have experiments made the electrician charges such high fees as to render investigation almost prohibitive. And as far as we have been able to make out, the magnetic results obtained by one professor may not coincide with those obtained by another. Moreover, there is undoubtedly a very strong apprehension on the part of manufacturers that the results of their experiments and investigations (arrived at after the expenditure of much time and money)

may be given to the world and thus competitors may, for nothing, be put in the way of competing to the great disadvantage of the original investigator. However, I may say that we have arrived at this stage, viz. that our dynamo magnet steel contains not more (on the average) than 0·3 to 0·4 per cent of impurities—and nearer the former than the latter."

Kapp's report on the samples submitted to him drew from the firm the comment: "If purity of material has anything to do with good magnetic curves . . . our minds are quite at rest as to the suitability of this material for dynamo magnets. And it is satisfactory to know that all the firms who have had our castings have expressed themselves favourably. . . . We have hitherto been under the impression that wrought iron dynamo magnets have been used indifferently for either arc or incandescent lighting; but the enclosed letter from the Thomson-Houston Co. would point to some difference between dynamo magnets for arc and for incandescent."

Woodward now (31.8.1893) wrote to Professor Ewing, at Langdale Lodge, The Avenue, Cambridge:— " . . . . During the last two years we have been making such castings to take the place of wrought iron forgings: and we think we may safely say that the difficulties which have hitherto characterized steel in bulk have been overcome. On the accompanying circular we show some of the forms of steel castings we have made of this special material, and we may add that we can cast it into almost any desired shape. . . . We would, with pleasure, send you some samples (taken from bulk) should you feel sufficiently interested in the subject."

In September, it was clear that because of this new material dynamo makers were having to alter their designs, and the firm made many castings the shapes for which could not have been produced as forgings. An order for five small magnet castings was actually received from a large firm in Berlin. The experiment was tried of adding 0·6 per cent copper to increase permeability, but Kapp's tests showed only an increase in solidity. The firm complained that "no-one has given us any idea of what we should aim at in this matter of dynamo magnet steel. To get as high permeability as that obtained from wrought iron has been our aim—or rather, we should say, a higher permeability."

In October of 1893, a user reported that by employing the new castings in one instance he had been obliged to take a considerable amount of copper off the magnet, and had also reduced the speed from 1,150 to 900 r.p.m., yet obtained higher efficiency than if he had used wrought iron forgings with the full quantity of copper and the higher rate of speed. He also reported that the new castings were less liable to heat than wrought iron forgings.

Larger Castings

Experiments were now proceeding with the production of larger dynamo magnet steel castings, and on 19th February, 1894, it was possible for the firm to indicate that "sometime in April we hope to be in a position to deal with lumps of four and five tons as castings." The steel contained an average of 99·7 per cent pure iron. In fact, the purity, oftener than not, was higher than that. Meantime, a curve made by the Electrical Standardizing Co., of Charing Cross Road, London, showed high permeability steel castings to be "better than wrought iron or any other steel, in the opinion of Lord Kelvin's chief assistant, Mr. Meikle . . . and several other electricians there" (in Glasgow).

Writing to Mr. Kapp on 17th April, 1894, Robert Woodward remarked: "We noticed that in the discussion on your paper (reported in *The Electrician,* 2nd March) a good deal was said about hysteresis. Dr. Fleming said, 'The question was partly an electrical one, partly a chemical one, and partly a mechanical one.' There isn't much information in that to guide a benighted steel manufacturer in making his dynamo steel. With the chemical and mechanical aspects we might deal, if we knew what is wanted, or what to avoid."

By May, 1894, the firm was able to accept orders for dynamo magnet steel castings weighing 5½ tons, the first such order being from Mather & Platt, Ltd., and amounting to about 34 tons in all. In June, Woodward went to meet Professor Ewing at Cambridge to discuss with him the possibility of obtaining accurate electrical data, as he was still far from being content with the tests so far carried out by Kapp and also by Professor Jamieson. Apparently Ewing's tests proved much more to his satisfaction as regards thoroughness, and an association between Ewing and the firm began and was to continue for a long period. The curves produced by Ewing were promptly included in a circular and widely distributed.

British Suppliers

By 1895, the dynamo magnet steel castings had so well established themselves in the market that the firm were compelled to refuse an order for about 130 tons from the Brush Electrical Engineering Co., Ltd., Loughborough, their foundry being full of this work for at least three months to come. At this date the percentage composition was given as 0·1 to 0·130 carbon, 0·066 to 0·1 silicon, manganese, trace to 0·07, iron, 99·72 to 99·6. A British competitor had now entered the field, a firm referred to as "Rogerson," of Wolsingham, Co. Durham (now the Wolsingham Steel Co., Ltd.), whose steel had a composition of carbon 0·220, silicon 0·382, manganese 0·676 per cent. The firm were asked in January, 1896, to guarantee that their dynamo magnet castings should yield certain magnet inductions at stated magnetizing forces. Such a guarantee had never previously been asked for, and the firm were not sure that the results would be the same in the hands of different operators. The values they were asked to guarantee were: H, 30, 40, 50, 60; B, 16,000, 16,300, 16,700, 16,900.

The castings may be said from this time onwards to have passed into the range of materials generally and widely accepted as essential for the manufacture of electrical equipment. Professor Ewing had supplied the makers with curves which they reproduced in their original circular showing the permeability values of the material. In 1925, it was decided that the time had come for new curves to be obtained, and the National Physical Laboratory combined with the University of Sheffield to supply these.

These newer curves were obtained in response to requests made by users of the steel castings in the electrical industry, who considered that as testing instruments and methods were far more accurate than twenty years previously, their calculations demanded newer figures based on these modern tests. The curves dealt with two distinct classes of material, into which dynamo magnet castings had been grouped, the original steel, and a steel of relatively high permeability, capable of meeting the physical test of B.E.S.A. Specification No. 17, 1921, Report No. 24, for castings without wearing surfaces. This steel was particularly useful where castings had to withstand mechanical stresses and permeability was not of paramount importance.

Ever since then, improvements in testing equipment and slight modifications and improvements of the castings themselves have been accompanied by the preparation and issue of new curves enabling electrical engineers and designers to base their calculations ever more dependably upon the latest data.

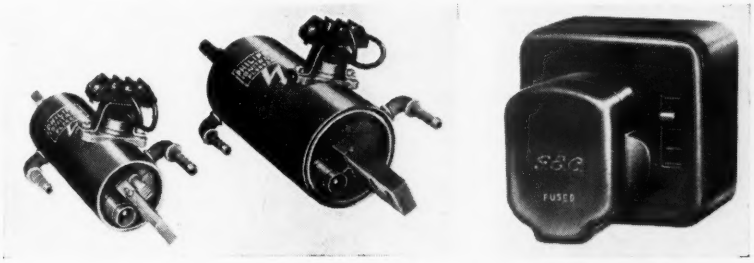
NEW ELECTRICAL EQUIPMENT

Thermostatically Controlled Ignitrons

PHILIPS ELECTRICAL, LTD., Century House, Shaftesbury Avenue, London, W.C.2, announces that it can now supply ignitrons fitted with thermostats to reduce the amount of cooling water used and to provide protection to the tube and associated equipment in case of water failure. It is stated that the water saving function, an important one when supplies of water free from mechanical or chemical pollution are difficult to obtain, is achieved with a minimum of wear on the solenoid valve.

Ignitrons can be used in existing installations, thus dispensing with a water flow switch. Use of a thermostat also eliminates risk of condensation on the tubes in high humidity conditions.

Three ignitrons are available, all being single-anode, mercury-pool tubes, stainless-steel jacketed to minimise corrosive effects and with ignitors of highly refractory material.

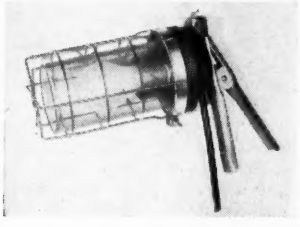


Thermostats mounted in position on the new Philips ignitrons

Improved Pattern Handlamp

The BRITISH CENTRAL ELECTRICAL CO., LTD., 6 & 8, Rosebery Avenue, London, E.C.1, announce that they have recently redesigned their shatterproof "Gripper" handlamp, simplifying its construction and facilitating its assembly and dismantling. The new construction dispenses with the grub screws which used to hold the ring retaining the "Perspex" cover in position. This cover is now removable very simply by hand, by unscrewing it, so that no screwdriver or other tools are necessary, and lamp insertion or replacement can be carried out in a few seconds. It also gives a tighter fit and makes for a much stronger mechanical assembly.

Improved pattern B.C.E. "Gripper" handlamp



Switch Socket and Plug

A new surface pattern 13A 3-pin "Mutac" switch socket outlet and plug comprising a silent a.c. switch and a shuttered 3-pin socket outlet mounted on a porcelain base has been developed by the GENERAL ELECTRIC CO., LTD., Magnet House, Kingsway, London, W.C.2. The overall brown Bakelite cover, measuring 2¾in by 2⅝in, is provided with a knockout on each of the four sides for use with surface wiring. A fused plug is supplied with each switch socket, fitted with a 13A fuse as standard, but 3 or 7A fuses can be supplied. The switch socket terminals are suitable for accepting either one, two or three 7/·029 conductors. Shutters, opened by the insertion of the earth pin of the plug, automatically screen the current carrying socket tubes. The catalogue number of the accessory is S.4955/2959 and the price complete with fused plug is 10s.

G.E.C. 13A 3-pin "Mutac" surface switch socket outlet and plug

Hair Dryer Hood Attachment

A useful attachment, suitable for converting a normal domestic hair dryer into a hood type model for home use, has recently been placed on the market by L. G. HAWKINS & CO., LTD., 30-35, Drury Lane, London, W.C.2. It consists of a two-piece tubular plastic stem, the bottom section of which is fitted with a metal clamp for attaching to a table top or any other suitable item of furniture, a plastic hood and a metal air deflector. When in use the hair dryer is fixed to the top tubular support by means of clips and the hood is slipped over the end of the nozzle and held in position by the air deflector clip. Ventilation holes are provided in the hood.

Hawkins home hair drying attachment

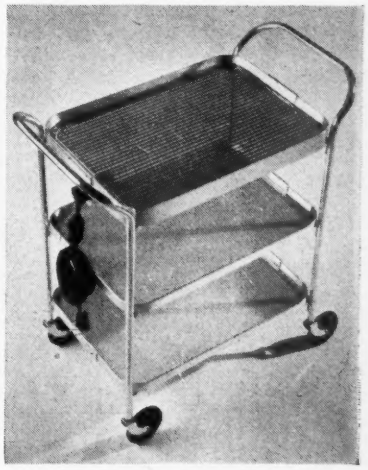
Although designed for the Hawkins "Supreme" hair dryer, the attachment is also suitable for other makes of dryers. The price complete is £1 13s 4d plus 7s 4d purchase tax in the United Kingdom. Replacement hoods are 9s each.

Heated Food Trolley

The introduction of an electrically heated model to the standard range of "Kaymet" food trolleys is announced by the KAYMET CO., 41, Kennington Lane, London, S.E.11. In this new model the top tray is replaced by two sheets of toughened, heat-resisting glass enclosing a 600 W heating element which covers nearly the whole of the top, giving it the appearance of a large mirror. It is suitable for use on the 200/250 voltage range or, to special order, 100/125 V.

Two sizes are available, 23 in by 16 in or 27 in by 16 in, in two- or three-tier models. Finish is in a range of anodized colours, with gold coloured fittings unless otherwise specified. A tray which fits over the heater unit can be supplied when it is not required to be used as a heated trolley.

"Kaymet" three-tier heated food trolley



INDUSTRIAL NEWS

British Columbia Cable Contract

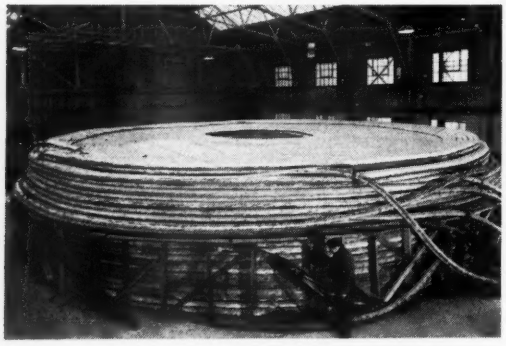
British Insulated Callender's Cables, Ltd., has been awarded a $2,000,000 contract by the British Columbia Electric Co., Ltd., Vancouver, for the supply of 9·9 circuit miles of single-core 230 kV oil-filled cable. The cable will be laid in ducts and will transmit power from existing 230 kV overhead lines at Kidd substation, on the north arm of the Fraser River, to distribution points in Greater Vancouver.

The cable will be of normal oil-filled single-core design, with a hollow copper conductor of 1·2 sq in cross-section. The lead-alloy sheath will have bronze tape reinforcement and special overall anti-corrosive protection. The cable will be manufactured at the Erith Works of B.I.C.C. and will be supplied in drum lengths up to 650 yards in order to reduce the number of joints needed. Joints and sealing ends will be of B.I.C.C. design and manufacture. The cable will be installed under the supervision of British Insulated Callender's Construction Co., Ltd., and is required to be energized by mid-1957. It will be capable of transmitting a continuous load of the order of 280 MVA.

H.V. Submarine Cable for Venezuela

Double line three-core 33 kV submarine cables, 17 miles in length and claimed to be the longest of their kind the the world, have just been shipped to Venezuela. They are part of a major scheme costing about £1½ million to provide electric power for production stations handling the oil from Compania Shell de Venezuela's well in Lake Maracaibo. Preference has been given to electricity because of its relatively low operating costs, its reliability of operation, its automatic control and reduced space requirements. The pair of cables will be laid from the power station at Las Morochas on the eastern shore to a step-down transformer station to be built on piles sunk in the Lake bed some 17 miles to the south-west. From there, power will be distributed by means of 11,500 V submarine cables to the production stations built over the Lake, where it will be further "stepped down" to drive electric motors operating at 440 V.

The pair of 33 kV submarine cables were manufactured at Woolwich by Siemens Bros. & Co., Ltd., in 1¼-mile lengths, which will be joined to form two supply lines of a continuous cable by means of submarine joint boxes. Siemens are also to lay the lines and their cable-laying ship, *Dashwood*, a converted collier, loaded the cable direct from the factory at Woolwich. It is estimated that the work on site will be completed in four to six weeks. The 11,500 V cable, supplied by the Telegraph Construction and Maintenance Co., Ltd., Greenwich, will be laid by Shell's own barges operating on Lake Maracaibo.



1,044-ton coil of finished cable at the Woolwich factory of Siemens Bros. & Co., Ltd., ready for dispatch to Venezuela

Telecommunications in Nigeria

One of the world's biggest radio-communications schemes is currently being carried out in Nigeria by Marconi's Wireless Telegraph Co. Ltd. The contract, which was awarded by the Nigerian Posts and Telegraphs Department, calls for the supply and installation of a country-wide point-to-point twin-path radio-telephone system covering over 2,000 miles and using more than £600,000 worth of equipment. The installation of the system is proceeding and the service is now operating from Lagos to Ibadan and will be available to the public as far as Benin City by the 1st April next. The continuation to Enugu will follow during the summer. Five main terminal and intermediate switching stations, four intermediate switching stations and twenty repeater stations will be incorporated in the complete project. At selected points along the routes local exchanges will be connected into the trunk circuits. Four, and in some cases, eight, telephone channels will be in operation, with provision for expansion to twenty-four channels when the traffic increases to demand this. The equipment being supplied includes thirty-four Marconi v.h.f. multi-channel terminal units, type HM.100; forty-six Marconi v.h.f. multi-channel repeater units, type HM.150; twenty-four automatic unattended duplicate diesel plants and five standby diesel plants. Telephone and telegraph carrier equipment is being supplied by Siemens Bros. and Co., Ltd., while the diesel plants are being manufactured by Pelapone Engines, Ltd.

E.M.I. Electronics Agreement

It is announced that an agreement has been concluded between E.M.I. Electronics, Ltd., and Industrial Electronics, East Sheen, London, S.W.14, whereby E.M.I. Electronics, Ltd., will in future, act as sole selling agents at home and overseas for Industrial Electronics' quantity produced instruments. These instruments will be integrated with the E.M.I. Electronics' range of instrument products.

Mechanical Handling Exhibition

More than 250 exhibitors will be participating in the Mechanical Handling Exhibition being held at Earls Court, London, from 9th to 19th May. In addition to its many thousands of exhibits, there will be a convention of speakers drawn from many countries, and showings of the latest materials handling films. Exhibits will include all types of industrial conveyors, elevators and stackers, hoists and pulley blocks, pneumatic handling plants, grain and powder handling plants, coal handling plants, fork-lift and other industrial trucks, cranes, and a wide range of accessories and appliances associated with mechanical handling. Tickets of admission can be obtained free on application to Mr. H. A. Collman, *Mechanical Handling*, Dorset House, Stamford Street, London, S.E.1.

Washing Machines on Television

A number of electric washing machines were shown in the B.B.C. afternoon television programme "Look and Choose" on 30th January. The programme took the form of questions and answers on the uses and advantages of washing machines. Lady Barnett was in the chair, the housewife was Mrs. Megan Moore and the machines were demonstrated by Miss Christine Begrie, lecturer in the Department of Household Science, Queen Elizabeth College. The British Electrical and Allied Manufacturers' Association was represented by Mr. O. H. Buckingham, a director of the Hotpoint Electric Appliance Co., Ltd.

Infra-Red Lamps in Plastics Production

One of the many interesting industrial applications of Philips infra-red Lamps is to be found at the Birmingham premises of Capon Heaton, Ltd., where they are used for the drying of p.v.c. and other thermo-plastic materials which, before processing, tend to absorb moisture. It is essential to good quality production that the grains, or "chips" of p.v.c.

Philips infra-red lamps being used in the processing of p.v.c. "chips" at the Birmingham factory of Capon Heaton, Ltd.

should be absolutely dry at the point where they are fed into the machines which mould them into the shapes required. Any moisture present would result in porosity in the finished extrusion and, hence, low physical properties. Each of the machines in use has a battery of four infra-red lamps suspended over the chute into which the "chips" are fed. The chute is mechanically vibrated, causing the "chips" to bounce and turn during their journey, and presenting all sides to the lamps' irradiation. It is stated that since the lamps were brought into regular use, a 25 per cent reduction in waste due to porosity has been effected.

Ceylon Contracts for Brush

Two large contracts for Ceylon with a total value of more than £610,000 have been secured by Brush Export, Ltd., in the face of world-wide competition. The orders, awarded by the Government of Ceylon Department of Electrical Undertakings, are for the supply and installation of equipment and large extensions to Pettah power station, Colombo (£425,000) and the equipping of a new power station at Jaffna, on the Northern Peninsula, at a cost of £186,000.

The Pettah contract covers the supply and installation of 12,000 kW of diesel generating plant, complete with all ancillary equipment including cooling and fuel handling plant, h.v. and l.v. switchgear, station transformers, cables and piping. All the preliminary design work was carried out by the General Engineering Division of Brush Export. As the contract calls for extensions to an existing power station, a considerable amount of extra design was necessary. The Division will be responsible for the complete electrical and mechanical installations, cable-laying and pipework, while the civil engineering side will be undertaken, on a sub-contract, by Hoares (Ceylon), Ltd., the Brush Group's agents in that country. This will include extensive piling, by a special process, under the new engine foundations, as within recent times the site of the existing power station was under the sea.

The diesel electric plant comprises six Mirrlees/Brush sets, each capable of developing 2,090 kW, running at 428 r.p.m. and generating at 11 kV, three-phase, 50 c/s. The diesel electric generating sets are powered by KVSS 12 engines, manufactured by Mirrlees, Bickerton and Day, Ltd. These are twelve-cylinder, vee-form, pressure-charged engines with air coolers and each has a continuous rating of 3,096 b.h.p. under normal temperature and pressure conditions. The nineteen-panel 250 MVA switchboard is of the Brush VA5 type.

The contract for Jaffna power station calls for the initial supply of four Mirrlees/Brush KSS 6 diesel generating sets, each developing 1,045 kW at 428 r.p.m. and generating at 11 kV. The power station building is being constructed by the Government of Ceylon according to a layout provided by Brush Export. It has been designed to allow for the installation, if required at some future date, of a Mirrlees KVSS 12 generating set with an output of 2,090 kW at 428 r.p.m. The Brush switchgear is a fifteen-panel 100 MVA board.

A feature of these two contracts is the interchangeability of spare parts for both types of engines and also the switchgear.

Heavy Duty Cooking Equipment

A large Benham heavy duty electric range has been made for Kent Oil Refinery, Isle of Grain. The stove consists of eight units, four on each side, with a steam heated bain marie at one end. Fully loaded the range takes 126·4. kW. Similar fittings are being made for Accra Hotel, Gold Coast, and also for University College Hospital, Nigeria.

New Nettle Premises

Additional premises, in Leestone Road, Wythenshawe, have been acquired by Nettle Accessories, Ltd. It is expected that these will enable the company to expand its range and eventually to give employment to a further 100 employees.

"Empress of Britain" Emergency Services

Batteries for emergency services aboard the new Canadian Pacific liner *Empress of Britain*, launched recently by the Queen, are being supplied to the builders, the Fairfield Shipbuilding and Engineering Co., Ltd., by Nife Batteries, of Redditch. Largest of the nine batteries ordered is that which is to be used to provide emergency lighting in the event of mains failure and for the operation of watertight doors. This battery consists of 200 heavy duty low resistance cells having a capacity of 235 Ah. If an emergency were to arise aboard ship it would supply 230 A for 30 minutes for emergency lighting and operate the seventeen 2 h.p. motors which close the watertight doors. The control cubicle includes the contactor for changing over the emergency lights from the mains to the battery on supply failure and also the necessary switching arrangements for dividing the battery into two parallel banks for charging from the ship's supply.

Of the eight smaller batteries to be supplied, four are of 22 cells each, two being used to operate low pressure services for luminous call bells, loudspeaking telephones, daylight signalling lamps and electric clocks, the remaining two supplying a current of 1·5 A for 24 hours for the operation of electric fire alarms. Two batteries of 20 heavy duty low resistance cells having a capacity of 235 Ah are being supplied for starting the engines to drive the emergency generator, and two more, each of 40 normal resistance cells having a capacity of 45 Ah will power the ship's telephone system.

G. Ellam, Ltd.

F. Hulme & Co., Ltd., Manchester, inform us that they have taken over the business of G. Ellam, Ltd., which recently went into formal liquidation. The continuity of the business of G. Ellam, Ltd., has not been broken and since the date of the appointment of a liquidator the business of the company has been continued by F. Hulme & Co., Ltd. A new company, G. Ellam, Ltd., has now been registered which will carry on this business under the proprietorship of F. Hulme & Co., Ltd.

Educational

Three post-graduate courses in science are being held at the University of Liverpool, Department of Extra-Mural Studies. They are as follows:—9th to 13th April, "Numerical Analysis and Digital Computing Machines; 8th to 13th April, "Fundamental Processes of Gaseous Discharges"; and 15th to 21st April, "Basic Principles of Nuclear Engineering." Full particulars can be obtained from the University, 9, Abercromby Square, Liverpool, 7.

A course of six lectures as an introduction to nuclear physics for engineers will be given by Mr. W. P. Jolly at the South East London Technical College, Lewisham Way, S.E.4, on Monday evenings, commencing on 20th February.

Wolf Tools in Australia

A manufacturing company, Wolf Electric Tools (Australia) Pty., Ltd., has been formed in Australia with a registered capital of £A.250,000. The site of the factory is approximately eight miles from Sydney. Initially, the factory is to specialize in the assembly of Wolf "Cub Homecrafts-

man" electric tools from components shipped by the British operating company, Wolf Electric Tools, Ltd. Later plans, however, include the manufacture of "Cub" equipment together with Wolf industrial tools from Australian produced components.

The directors of the Australian company are Mr. D. K. Nicholas, Mr. B. E. Nicholas, and Mr. R. A. G. Hardy, all of whom are Australian residents and have been connected with the electric tool industry for many years, and Mr. H. Richards and Mr. G. M. Wolfe who are also directors of the parent company. Mr. Hardy was previously assistant works manager at the British operating company's works at Hanger Lane, London, W.5.

Plant for South Africa

A 60 MW G.E.C. turbo-alternator has recently been delivered for the Wilge power station of the Electricity Supply Commission of South Africa. Wilge power station is some 5,100 ft above sea level in the Kendal district of the Transvaal and will supply the power required for the development of uranium deposits in the Witwatersrand Gold Mines as well as augmenting the supply for gold mining and industrial purposes. The alternator is air-cooled and was manufactured at the Witton Works of the General Electric Co., Ltd., while the turbine, which is designed for a steam pressure of 600 lb/sq in gauge, 850 deg F, was built at the company's Fraser & Chalmers Engineering Works, Erith.

Aluminium Production in India

Aluminium, Ltd., of Montreal, states that construction work is expected to start this year on a new Canadian-backed aluminium smelter in India which will more than double that country's present aluminium production by 1958. The statement says that late in 1955, following lengthy studies and negotiation, the Indian Aluminium Co., Ltd., decided to proceed with the erection of an aluminium smelter of 10,000 tons annual capacity at Hirakud, Orissa. The smelter will be developed in conjunction with a new multi-purpose power project now nearing completion by the Government of Orissa and will be capable of further expansion to 20,000 tons capacity as conditions warrant.

Solartron Activities

The Merchandising Division of the Solartron Electronic Group, Ltd., is staging an exhibition of electronic instruments manufactured by overseas manufacturers for whom it acts as sole United Kingdom selling agents at the Hotel Russell, London, W.C.2, on 21st, 22nd and 23rd February. Admission will be by ticket, issued free of charge, on application to Mr. C. G. Bailey, Merchandising Division, the Solartron Electronic Group, Ltd., Thames Ditton, Surrey.

The Solartron Research and Development, Ltd., the company in the group responsible for research and development on laboratory and industrial electronic instruments, has now removed to its new headquarters at "Goodwyns Place," Dorking, Surrey (telephone: Dorking 4661).

Mr. Ambika Prasad, who joined the Export Division of the Solartron Electronic Group, Ltd., in 1954, is now in charge of the group's export business with the Far East.

A well produced and illustrated booklet has been issued describing the activities of the five companies forming the Solartron Electronic Group.

Mr. J. E. Bolton, chairman and managing director of the Solartron Electronic Group, Ltd., states that the prices of its electronic instruments will not be increased during the next six months.

E.A.W. Awards

The following awards for electrical housecraft advisers are announced by the Electrical Association for Women:—Elizabeth Sloan Chesser Cup: Mrs. C. M. Roper (North Western Electricity Board, Blackburn). Runner-up: Miss O'Connor (General Electric Co., Ltd., Plymouth). Councillor Miss Walter Rosebowl: Dame Allan's School for Girls, Fenham, Newcastle-upon-Tyne. Runner-up: Campden Institute Secondary Technical School, London. Cheltenham silver jubilee awards to housewives gaining the highest marks in the home workers' examination: First prize (£5) to Mrs. I. M. Evans (Swansea); second prize (£3) to Mrs. A. M. Scott (Edinburgh); and third prize (£2) to Mrs. G. Newton (Edinburgh).

The certificate examination in electrical housecraft for demonstrators and saleswomen was held on 8th December when 67 candidates qualified for the certificate, 9 gaining distinction. The total number of certificate holders is now 2,375.

In the certificate examination for teachers held on 10th December, 29 candidates qualified for the certificate, making the total number of certificate holders 2,034.

Television and V.H.F. Wavebands

The British Broadcasting Corporation has issued a diagram showing the present allocation of Bands I, II and III for v.h.f. sound broadcasting and television. Application has been made by the Corporation for channels in Band III for its second television programme service, but the Postmaster General has not yet announced any further allocation of channels in this band. The chart does not show Bands IV and V, which extend from 470 to 585 and from 610 to 960 Mc/s. These will in due course be divided into television channels, but the number of channels and their allocation are not yet decided.

Trade Announcements

The Preston branch of **Lionel Robinson & Co., Ltd.**, is now at 161-3, Eldon Street (telephone Preston 57975-6).

To assist the sale and display of "Atlas" fluorescent starter switches, **Thorn Electrical Industries, Ltd.**, has produced a series of handy new packs of attractive appearance. The two sizes of "Atlas" switch are each being supplied in boxes of one dozen, with an individual pack for each switch bearing a design theme similar to the outer carton. The colour scheme on all packs is Coronation red and blue, with bold white lettering.

The Leicester sales office of **Brook Motors, Ltd.**, is now at 1, Saxby Street, Leicester (telephone: Leicester 20648-9).

The London showrooms of the **Simplex Electric Co., Ltd.**, are now at Creda House, 26-28, Binney Street, W.1, (telephone: Grosvenor 6951-6).

CATALOGUES AND LISTS

CABLE FITTINGS.—Catalogue describing the company's range of solderless terminals, cable lugs and crimping equipment for industrial applications.—**Erma, Ltd.**, Hong Kong Works, Exhibition Grounds, Wembley, Middlesex.

CABLES.—104-page catalogue (358) dealing with the company's paper insulated cables for voltages up to 33 kV.—**British Insulated Callender's Cables, Ltd.**, 21, Bloomsbury Street, London, W.C.1.

CONVEYOR PLANT.—20-page booklet illustrating coal, coke and ash handling plants at various power stations, wagon tippers, skip hoists and other conveying plant.—**Robert Dempster & Sons, Ltd.**, Rose Mount Iron Works, Elland, Yorks.

MOTORS.—Illustrated leaflets describing the company's S.D.18 f.h.p. induction motor and their S.D.19 and S.D.20 geared motor units.—**Parvalux, Ltd.**, Broom Road, Parkstone, Dorset.

PIPEWORK.—106-page illustrated descriptive catalogue dealing with pipework and ancillary equipment for power stations and other industrial uses.—**Aiton & Co., Ltd.**, St. Stephen's House, Victoria Embankment, London, S.W.1.

RECTIFIERS.—Illustrated booklet describing industrial selenium rectifier equipment.—**General Electric Co., Ltd.**, Magnet House, Kingsway, London, W.C.2.

SPACE HEATING.—28-page priced catalogue covering electric fires, convectors and other space heating equipment.—**Rich & Pattison (B'ham), Ltd.**, 81, Jamaica Row, Birmingham, 5.

STEAM IRONS.—Folder and price list illustrating and describing the "Simons" electric steam ironing units, and a leaflet on the "Danor" heat control unit for use with non-automatic electric irons.—Danor Engineering Ltd., 170, Pentonville Road, London, N.1.

TRANSFORMERS.—Twelve price lists giving figures for various types of transformers in the company's range.—**Foster Transformers, Ltd.**, South Wimbledon, London, S.W.19.

GENERATION AND DEVELOPMENT

Tariff Stabilization

In response to the Prime Minister's appeal for help in the economic situation by pegging prices, the South of Scotland Electricity Board has decided not to increase its tariffs this year and its hoped to be able to give a similar assurance for 1957. Announcing this the chairman, Mr. J.S. Pickles, said that so far as the domestic tariff was concerned the decision had been taken irrespective of fluctuation in the price of coal or in the cost of wages and salaries. In the case of industrial and commercial tariffs the price gaurantee was subject to fuel clauses contained in the tariffs agreement, but the basic tariff would not be increased. One exception to the Board's decision related to street lighting, the present tariff for which wd shortly be standardized throughout the District, involving increases in some case

Progress in Cornwall

"This year marks yet another record in the progress of electricity service in Cornwall, for the engineers of the South Western Electricity Board have now provided 1,000 miles of new mains in Cornwall since the industry came under public ownership in 1948." This was stated by Mr. Harold Midgley, deputy chairman of the South Western Electricity Board, when he spoke at the annual dinner of the Board's Cornwall Sub-Area staff at Newquay on 27th January. Mr. Midgley said that 35,000 consumers including more than 3,000 farms had been connected to the mains in Cornwall in just under eight years.

The people of Cornwall were among the most electrically minded in the country, he said. The demand for electric cookers in Cornwall had doubled in eight years and six times as many housewives were now installing electric water heaters. He also referred to the growing use of electricity in agriculture and said that Cornwall had played a leading part in developing the use of electrical grain drying equipment. Five years ago there were only 19 grain dryers in use in the whole of the West Country; to-day there were nearly 200, of which over 60 were installed in Cornwall. There had also been important progress in providing industrial power supplies for the china clay industry and for quarrying and stone crushing.

Mr. Midgley said that the "credit squeeze" had cast its shadow at a time when, in the South West, the rapidly rising demand for electricity called for a steadily increasing investment in new mains and distribution networks. Control by an overall percentage cut in total capital allocations tended inevitably to bear most severely on those who had practised the greatest economy and from financial necessity the South Western Board had always exercised the strictest economy in capital expenditure.

Purchase Tax on Utensils

At its quarterly meeting the Southern Electricity Consultative Council noted with concern that though the Board had been asked by the Council to make representations to the Government in respect of purchase tax on certain cooking utensils essential for the efficient use of electric cookers the Board had in fact referred the matter to the Electrical Development Association. The Council passed a resolution to the effect for the attention of the Board.

Cooking Facilities at Consett

The North Eastern Electricity Board has pointed out to Consett U.D.C. that since the war the Board has spent £61,000 (equal to £60 a house) on capital developments in the area but is not getting an adequate return. The Council has recently built houses with solid fuel cooking facilities only, whereas it was its original custom to build 25 per cent with electricity, 25 per cent with gas and the rest for solid fuel.

Hayle Power Station

The Central Electricity Authority has received the consent of the Minister of Fuel and Power to the extension of the Hayle power station, Cornwall, by the installation of a 20,000 kW turbo-generator and a 200,000 lb/hr boiler unit. With this new generating set the station will have a total installed capacity of 87,800 kW.

Burnley Hospital Installation

Manchester Regional Hospital Board has approved the carrying out of electrical installation work at Burnley General Hospital at an estimated cost of £33,118. The hospital is to be completely rewired with an a.c. ring circuit. The d.c. plant will be retained for the supply of electricity to the laundry and will be a reserve in case of any breakdown in grid supplies.

Link with Robert Burns

On 29th January, the 197th anniversary of the birth of Robert Burns, the South of Scotland Electricity Board, with fitting ceremony, switched on an electricity supply at Ellisland farmhouse, in Dumfriesshire, where he had lived for a time. Members of the Board's Dramatic Society, in period costume, drove to Ellisland in a carriage drawn by two grey horses and after a welcoming address by Bailie W. Wallace, president of the Dumfries Burns Club, Mr. John Power, who played the part of the poet, delighted the company with appropriate verses before pressing the switch to bring electricity to the farm. The company then toured the house, now a museum of Burns relics, paying particular attention to the kitchen where a haggis was cooking on the new electric cooker. After the ceremony the party returned to Dumfries to partake of a traditional meal at the Globe Inn.

"Robert Burns" (John Power) and "Jean Armour" (Christine McRobbie) view with delight the haggis just removed from the pot by Mrs. Johnston, the present tenant of Ellisland

Financing Kariba Project

Speaking in London last week, Sir Gilbert Rennion, High Commissioner for Rhodesia and Nyasaland, said that the Federal Government was confident that the money for the Kariba hydro-electric scheme would be available, though negotiations with the International Bank, the Colonial Development Corporation and other possible lenders had not been completed. The first stage of the project was now estimated to cost more than the original estimate of £54 million. The scheme involved the damming of the Zambesi River and the formation of the largest man-made lake in the world—about 150 miles long and averaging 13 miles wide.

Sir Gilbert, who was presenting a paper on recent developments in the Federation to the Commonwealth Section of the Royal Society of Arts, said that the Federal Government considered the scheme essential to the future progress and prosperity of the country, its rapidly developing industries and towns and its people, and financially as a very sound proposition. Commenting on the mining industry, he said that copper production in 1955 should easily exceed the £100 million mark for the first time in the country's history.

NEW PATENTS

Electrical Specifications Recently Published

The numbers under which the specifications will be printed and abridged are given in parentheses. Copies of any specification (3s 0d each including postage) will be obtainable after 14th March from the Patent Office, 25, Southampton Buildings, London, W.C.2.

1950

22450. Barrow, J. E., and Robbins, R. C. —Electric pulse generating or distributing circuits. 5th September, 1951. (746,591.)

31642. Thorn Electrical Industries, Ltd. —Luminescent materials. 5th December, 1951. (746,271.)

1951

5942 and 20891. Thorn Electrical Industries, Ltd.—Luminescent materials. 4th March and 29th August, 1952. (746,272/3.)

1952

4647. Napier & Son, Ltd., D.—High frequency electrical condensers. 16th January, 1953. (746,171.)

21436 and 21488. Mullard Radio Valve Co., Ltd.—Line time base circuits particularly for television receivers. 31st July, 1953. (746,175/6.)

30299. National Research Development Corporation.—Flameproof electrical apparatus. 30th November, 1953. (746,281.)

33042. Porter Electrical Products, Ltd.—Clamp for electric conductors. 29th December, 1953. (746,180.)

1953

1657. General Electric Co., Ltd., Dettmer, D. E. G., and Ledbetter, J.—Vents for oil-filled electrical apparatus. 12th January, 1954. (746,476.)

4420. Besson & Robinson, Ltd., and Besson, A. P.—Electromagnetic mercury relays. 17th February, 1954. (746,184.)

14478. Standard Telephones & Cables, Ltd.—Electrical circuits using two-electrode devices. 22nd May, 1953. (746,490.)

15028. Metropolitan-Vickers Electrical Co., Ltd.—Electrically operated hoists, winders and the like. 19th May, 1954. (746,493.)

17337. Westinghouse Brake & Signal Co., Ltd., Walker, A. H. B., and King, K. G.—Alternating voltage wave-form distorting circuits. 10th May, 1954. (746,495.)

22174. Nationaal Luchtvaartlaboratorium. —Electric circuits for measuring rotation speeds and/or for totalizing revolutions. 11th August, 1953. (746,191.)

23515. Brookhirst Switchgear, Ltd., and Roberts, W. E.—Sequence-operating control systems for electric motors and control switches for use in such systems. 11th August, 1954. (746,601.)

23870. Sylvania Electric Products, Inc.—Electroluminescent display devices. 28th August, 1953. (746,502.)

25235. English Electric Valve Co., Ltd.—Television camera tubes. 14th July, 1954. (746,504.)

25338. British Thomson-Houston Co., Ltd.—Glass composition. 10th August, 1954. (746,192.)

29976. Nationaal Luchtvaartlaboratorium. —Electronic frequency meter. 29th October, 1953. (746,195.)

33814. Metropolitan-Vickers Electrical Co., Ltd.—Dynamo-electric machines. 17th November, 1954. (746,288.)

1954

201. Thorn Electrical Industries, Ltd.—Luminescent materials. 5th December, 1951. (746,289.)

252. Western Electric Co., Inc.—Telephone line-finder switches. 5th January, 1954. (746,290.)

688. General Motors Corporation.—Electrical systems for automatically dimming vehicle headlamps. 11th January, 1954. (746,398.)

2509. Telefonaktiebolaget L. M. Ericsson.—Polarized a.c. bells. 27th January, 1954. (746,294.)

2692. General Motors Corporation.—Electric clocks. 29th January, 1954. (746,408.)

2748. Standard Telephones & Cables, Ltd.—Colour television receiving system. 29th January, 1954. (746,295.)

2749. Standard Telephones & Cables, Ltd.—Transparent luminescent screen. 29th January, 1954. (746,536.)

3060. Clevite Corporation.—Magnetic transducer heads. 2nd February, 1954. (746,537.)

3194. Leclanche Soc. Anon.—Insulating ducts for passage of electric conductors through conductive walls. 3rd February, 1954. (746,296.)

3476. Electric Storage Battery Co.—Electric storage battery plates. 5th February, 1954. (746,232.)

4194. Standard Telephones & Cables, Ltd.—Pulse generator circuit with frequency stabilization. 12th February, 1954. (746,622.)

4229. Porter, A. E.—Radar reflectors. 11th August, 1954. (746,300.)

4287. Dupont, R.—Electric vulcanizing outfits. 13th February, 1954. (746,302.)

4573. Elektrokemisk Aktieselkap. —Söderberg electrodes for aluminium electrolysis, and electrode paste for making such electrodes. 16th February, 1954. (746,625.)

4948. Western Electric Co., Inc.—Devices for rotating the plane of polarization of plane-polarized electromagnetic waves. 19th February, 1954. (746,305.)

5442. Western Electric Co., Inc.—Electrical attenuation equalizers. 24th February, 1954. (746,236.)

5746. Naamlooze Vennootschap Hollandse Signaalapparaten.—Radar apparatus. 26th February, 1954. (746,629.)

5897. Standard Telephones & Cables, Ltd. (Federal Telecommunication Laboratories, Inc.).—Electric multi-channel pulse code communication systems. 1st March, 1954. (746,237.)

6162. Compagnie Générale de Télégraphie sans Fil.—Coaxial output devices. 2nd March, 1954. (746,419.)

6375. Egyesult Issolampa es Villamosagi R. T.—Supply cathodes. 4th March, 1954. (746,548.)

7050. General Motors Corporation.—Compressor units for refrigeration systems. 11th March, 1954. (746,549.)

7686. Lignes Télégraphiques et Téléphoniques.—Surface wave transmission lines. 16th March, 1954. (746,316.)

7948. Soc. Alsacienne de Constructions Mécaniques. — Tubular conductors and methods and apparatus for manufacturing same. 18th March, 1954. (746,637.)

8292. Philips Electrical Industries, Ltd. —Devices for recording sound oscillations in spiral grooves on planar carrier. 22nd March, 1954. (746,551.)

8341. General Electric Co.—Unilaterally conductive devices. 22nd March, 1954. (746,638.)

9098. Westinghouse Electric International Co.—Electrostatic precipitators. 29th March, 1954. (746,324.)

9231. Bosch Ges., R.—Electric over-voltage safety devices. 30th March, 1954. (746,426.)

10341. Clarostat Mfg. Co., Inc.—Rotary electric snap switch. 8th April, 1945. (746,642.)

11218. Gretener, E.—Arc lamps. 15th April, 1954. (746,328.)

11367. General Electric Co.—Insulated electric cable. 20th April, 1954. (746,330.)

12090. Jeffree, A. F.—Electric hand or floor polisher. 27th April, 1954. (746,332.)

12416. Allmänna Svenska Elektriska Aktiebolaget.—Arrangement for the high speed reclosing of electrical power lines. 29th April, 1954. (746,646.)

12728. Brown, W. J.—Electric motor control systems. 3rd May, 1954. (746,213.)

13381. Babcock & Wilcox, Ltd.—Damper means for tubulous fluid heat-exchangers. 19th December, 1952. (746,335.)

15092. Speer A.—Electric baking and roasting oven. 21st May, 1954. (746,652.)

17070. Soc. des Accumulateurs Fixes et de Traction.—Electric lighting apparatus. 10th June, 1954. (746,570.)

17722. General Electric Co.—Insulating wrapping for electrical conductors. 16th June, 1954. (746,219.)

17936. Ateliers de Construction Électriques de Charleroi.—System for detecting a faulty control unit in regulating three or more transformers under load. 18th June, 1954. (746,220.)

17962. Hazeltine Corporation.—Image-reproducing system for colour-television receiver. 18th June, 1954. (746,345.)

18377. Allmänna Svenska Elektriska Aktiebolaget.—D.c. machine for transforming a variable primary voltage into a constant secondary voltage. 23rd June, 1954. (746,346.) 18378. Compensating winding for electrical machines. 23rd June, 1954. (746,242.)

19621. Katzman, M.—Vaporizer electric heating element. 5th July, 1954. (746,247.)

19669. Hoover, Ltd.—Suction cleaners. 5th July, 1954. (746,348.)

19777. General Electric Co.—Electric cord arrangement for vacuum cleaners. 6th July, 1954. (746,453.)

20625. Philips Electrical Industries, Ltd. —Amplitude modulator circuits. 14th July, 1954. (746,657.)

21264. Philips Electrical Industries, Ltd. —Fluorescent electric lighting installations. 21st July, 1954. (746,577.)

24001. Babcock & Wilcox, Ltd.—Vapour and liquid separating means for forced flow, once through, tubulous vapour generators. 18th August, 1954. (746,459.)

24758. General Motors Corporation.—Control system for an electric locomotive. 25th August, 1954. (746,461.)

25551. Soc. Anon. des Etablissements L. Hatot.—Electromagnetic impulse device for driving clocks. 2nd September, 1954. (746,465.)

26307. Philips Electrical Industries, Ltd. —Electric-current conductors. 10th September, 1954. (746,261.)

30884. Marryat & Place, Ltd.—Electrical duct or trunking. 26th October, 1954. (746,367.)

32567. General Electric Co.—Waste disposal apparatus. 10th November, 1954 (746,659.)

32871. Felten & Guilleaume Carlswerk Akt.-Ges.—Pressure-tight lead-in arrangements in submerged repeaters in deep-sea telecommunication cables. 12th November, 1954. (746,660.)

34581. Standard Telephones & Cables, Ltd.—Electrical power supply equipment with stand-by. 29th November, 1954. (746,268.)

35435. General Electric Co.—Refrigerators. 7th December, 1954. (746,469.)

36039. British Thomson-Houston Co., Ltd.—Operation of excited synchronous motors. 13th December, 1954. (746,470.)

NEXT WEEK'S EVENTS

Organizers of electrical functions are advised to make use of the "Electrical Review" clearing house, Room 221, Dorset House, Stamford Street, London, S.E.1, to ascertain that proposed dates for their functions do not clash with others already arranged.

Monday, 13th February

BIRMINGHAM.—Regent House, St. Philips Place, Colmore Row, 6 p.m. I.E.E. South Midland Supply and Utilization Group. "Flat Pressure Cable," by J. S. Hall, A. H. Gray, S. J. Mollerhoj, A. M. Morgan and C. T. W. Sutton.

CARDIFF.—At the South Wales Institute of Engineers, Park Place, 6 p.m. I.E.E. Western Centre. "Automatic Circuit Reclosers," by G. F. Peirson, A. H. Pollard and N. Care.

CHELTENHAM.—Rotunda, 7.30 p.m. Society of Instrument Technology, Cheltenham Section. Presidential address.

HULL.—Y.E.B., Ferensway, 7 p.m. I.E.S. Leeds Centre. "Cold Cathode Lighting," by G. Robinson and A. E. Fothergill.

LEICESTER.—Demonstration Theatre, Electricity Offices, Charles Street, 6.45 for 7 p.m. Leicester Electrical Society. "Electrical Engineering in a Coal Mine," by R. J. Pickering.

LONDON.—Savoy Place, W.C.2, 6 p.m. I.E.E. Education Discussion Circle. Discussion on "Power Supplies to Electrical Laboratories," opened by Dr. P. F. Soper.

St. Ermins Hotel, Caxton Street, S.W.1, 7 p.m. A.S.E.E. Central London Branch. "Underground Railways Electrical Practice" by R. H. Tintalf.

MANCHESTER. — Engineers' Club, Albert Square, 7 p.m. Junior Institution of Engineers, North-Western Section. "Variable Speed Gears and some Industrial Applications," by M. Carter and J. Fieldhouse.

NEWCASTLE-UPON-TYNE. — Neville Hall, 6.15 p.m. I.E.E. North Eastern Centre. Chairman's address to the Utilization Section. "The Opportunities, Responsibilities and Recruitment of Professional Electrical Engineers in Industries other than the Electrical Industry," D. B. Hogg.

NORWICH. — Assembly House, 7.30 p.m. I.E.E. East Anglian Sub-Centre. "Timing the Operation of Control Systems associated with Rotating Equipment," by C. Cuthbert and D. A. Picken and "The Dynamic Braking of Induction Motors," by Dr. D. Harrison.

SHEFFIELD. — The University, Western Bank, 6.30 p.m. I.E.S. Sheffield Centre. "Photometric and other Tests for Street Lighting," by W. A. Varney.

SOUTHAMPTON.—The Guildhall, 6.30 p.m. I.E.E. Southern Centre. Faraday Lecture: "Coal Mining Electrically," by B. L. Metcalf.

WEMBLEY.—Century Hotel, Forty Avenue, Wembley Park, 8.15 p.m. A.S.E.E. North-West London Branch. "Space Heating by Electricity" by R. D. Jackson.

Monday, 13th February, to Friday, 24th February

BIRMINGHAM.—247, Chester Street, Aston. Midlands Electricity Board. Heating and Ventilating Exhibition.

Tuesday, 14th February

BELFAST.—Queen's University, 6.30 p.m. I.E.E. Northern Ireland Centre. "TRIDAC—A Large Analogue Computing Machine," by Lt.-Cmdr. F. R. J. Spearman, J. J. Gait, A. V. Hemingway and R. W. Hynes.

BOURNEMOUTH.—Grand Hotel, Firvale Road, 8 p.m. A.S.E.E. Bournemouth Branch. Melling Lecture "Installation and Operation of a Television Station" by E. P. B. Metcalfe.

BRADFORD. — I.E.E. North Midland Graduates' & Students' Section. 7 p.m. "The Protection of Electrical Supply Networks," by E. G. Hopper.

BRISTOL.—Grand Hotel, Broad Street, 7.30 p.m. Institution of Engineering Inspection, South-Western Branch. "The Manufacture and Uses of Tufnol."

CAMBRIDGE.—Technical College, 6 p.m. I.E.E. Cambridge Radio & Telecommunication Group. "Quartz Crystals for v.h.f. Communication," by N. C. Rolfe.

CHELMSFORD.—Public Library, 7 p.m. I.E.E. London Graduates' & Students' Section, district meeting. "Television Outside Broadcast Control Units," by F. H. Steele.

DONCASTER.—Danum Hotel, 7 p.m. Institution of Production Engineers, East and West Ridings Region, Doncaster Section. "Industrial Applications of Atomic Energy," by H. Lysons.

LONDON.—Savoy Place, W.C.2, 5.30 p.m. I.E.E. Measurement & Control Section. "An On-Off Servomechanism with Predicted Change-Over," by J. F. Coales and A. R. M. Noton.

Grosvenor House, Park Lane, W, 6.30 for 7 p.m. Electrical Contractors' Association. Annual dinner.

Savoy Hill, W.C.2., 6 p.m. Illuminating Engineering Society. "Lighting at London Airport," by J. G. Holmes.

Connaught Rooms, 12.30 for 1 p.m. Electrical Industries Club luncheon. Speaker, C. Halford Reddish, chairman, Rugby Portland Cement Co.

LUTON.—Midland Hotel, Williamson Street, 8 p.m. A.S.E.E. Luton Branch. "Automatic Temperature Control" by S. O. Grant.

RUGBY.—Rugby Radio Station, 6.30 p.m. I.E.E. Rugby Sub-Centre. "The New High-Frequency Transmitting Station at Rugby," by C. F. Booth and B. N. MacLarty.

SLOUGH.—Community Centre, Farnham Road, 7.30 p.m. Institute of Welding, Slough Section. "The Part of Resistance Welding in Automation," by R. W. Ayers.

WORKINGTON.—Cumberland Technical College, 7 p.m. I.E.E. North-Eastern Centre. "The Future of Electronics in Industry," by E. R. Davies.

Wednesday, 15th February

GLASGOW.—Burlington House, Bath Street. 7.30 p.m. Institute of Metal Finishing. Dance and Social.

LONDON. — Central Hall, Westminster, 6 p.m. Institution of Electrical Engineers. Faraday Lecture: "Coal Mining Electrically," by B. L. Metcalf.

Waterloo Bridge House, 5 p.m. Institution of Post Office Electrical Engineers, London Centre. "Work Unit Assessment and Employment," by C. E. E. Clinch.

MANCHESTER. — Engineers' Club, Albert Square, 6.45 p.m. I.E.E. North-Western Radio and Telecommunication Group. "Pulse-Time-Modulation Terminals for Music Transmission over Radio Links," by R. F. Rous.

MIDDLESBROUGH.—Cleveland Scientific and Technical Institute, Corporation Road, 6.30 p.m. I.E.S. Tees-Side Group. "Prescribing for Seeing," by M. L. Berson.

NEWCASTLE-UPON-TYNE.—King's College, 7 p.m. Society of Instrument Technology, Newcastle Section. "Ultrasonics," by E. G. Richardson.

NEW MALDEN.—I.E.E. London Graduates' and Students' Section. Visit to Decca Record Co., Ltd., at 2.30 p.m.

NORTHAMPTON. — College of Technology, 7.15 p.m. Northampton & District Electrical Association. "Motor Control Gear for Light Industrial Drives," by P. C. Belton.

PRESTON.—19, Friargate, 7.15 p.m. I.E.S. North Lancashire Group. "Recent Work on Discomfort Glare," by R. G. Hopkinson and P. Petherbridge.

ROCHESTER.—Bull Hotel, 7 p.m. Incorporated Plant Engineers, Kent Branch. "Diesel Engine Development," by R. W. Stuart Mitchell.

SHEFFIELD.—Grand Hotel, 6.30 p.m. I.E.E. Sheffield Sub-Centre. "The Supply of Electricity in the London Area," by D. B. Irving.

Royal Victoria Hotel, 2.30 p.m. Institute of Fuel, Yorkshire Section. "Solid-Fuel-Burning Gas Turbines," by J. D. Thorn.

Thursday, 16th February

CHELMSFORD. — Crompton's Social Hall, 7.30 p.m. Chelmsford Engineering Society. "The New Rugby Short Wave Transmitting Station," by Capt. C. F. Booth.

COVENTRY.—E.M.E.B. Staff Canteen, Sandy Lane. Electrical Association for Women, Coventry Branch. "Home Lighting," by Jean L. Stewart.

DUBLIN.—Trinity College, 6 p.m. I.E.E. Irish Branch. "Electrical Energy from the Wind," by E. W. Golding.

GLASGOW. — 39, Elmbank Crescent, 7.30 p.m. Institution of Production Engineers, Scottish Region, Glasgow Section. "Electro-Spark Machining," by G. Fefer.

INVERNESS.—Burnett's Tearooms, 7 p.m. I.E.E. North Scotland Sub-Centre. "Highland Water Power—The Developments of the North of Scotland Hydro-Electric Board," by the late Mr. T. Lawrie, to be read by an officer of the Board.

LIVERPOOL.—At the Royal Institution, Colquitt Street, 7.15 p.m. Incorporated Plant Engineers, Merseyside & North Wales Branch. "Steam Turbines in Plant Engineering," by Prof. W. J. Kearton.

LONDON.—Savoy Place, W.C.2., 5.30 p.m. I.E.E. Utilization Section. "The Theory and Characteristics of the 3:1 Pole-Changing Induction Motor" and "Applications of the 3:1 Pole-Changing Motor," by Dr. T. H. Barton, O. I. Butler and H. Sterling and "The Development of a New 3:1 Pole-Changing Motor," by Prof. G. H. Rawcliffe and B. V. Jayawant.

East Ham Technical College, Arragon Road, E.6., 7 p.m. Ministry of Works. "Powered Hand Tools," by A. F. Coare.

32, Welbeck Street, W.1. British Institute of Radiology. "Some Recent Developments in Wedge Field Therapy," by G. W. Boden and M. Cohen.

Caxton Hall, S.W.1., 2.30 p.m. Diesel Engineers' and Users' Association. "Cast Irons for Diesel Engines," by Dr. Ing. J. G. Pearce.

Woolwich Polytechnic, 7.30 p.m. Institute of Industrial Supervisors, London South-East Section. "Automatic Control," by Dr. J. S. Tait.

MANCHESTER.—N.W.E.B., Town Hall Extension, 6 p.m. I.E.S. Manchester Centre. "Recent Work on Discomfort Glare," by R. G. Hopkinson and P. Petherbridge.

NEWCASTLE-UPON-TYNE. — Stephenson Building, King's College, Claremont Road, 6.15 p.m. Institute of Marine Engineers, North East Coast Section. Annual general meeting, followed by "Advanced Machinery Installations designed for the Maximum Saving in Weight and Space," by Dr. T. W. F. Brown, P. Jackson and E. H. Smith.

TONBRIDGE.—Rose & Crown Hotel, 8 p.m. A.S.E.E. Kent Branch. "Safety in Electrical Installations."

WATFORD.—Clarendon Hotel, Station Road, 8.15 p.m. A.S.E.E. Watford Branch. "Electricity in the Marine Industry" by J. Bushby.

Friday, 17th February

LONDON. — Connaught Rooms, W.C.2, 12.15 for 1 p.m. Electrical Trades' Commercial Travellers' Association. Annual luncheon.

MANCHESTER.—Engineers' Club, Albert Square, 6.45 p.m. Manchester Association of Engineers. "Diesels," by C. J. Hind.

STONE.—Crown Hotel, 7 for 7.30 p.m. I.E.E. North Staffordshire Sub-Centre. Annual dinner.

Saturday, 18th February

OXFORD.—Y.M.C.A., 10, George Street, 6.30 p.m. A.S.E.E. Oxford, Reading and Districts Branch. "Radio Frequency Heating" by B. Kellett.

CONTRACT INFORMATION

Accepted Tenders and Prospective Electrical Work

CONTRACTS OPEN

Where "Contracts Open" are advertised in our "Official Notices" section the date of the issue is given in parentheses.

Australia.—15th March. Southern Electric Authority of Queensland, Brisbane. Metal clad switchgear. (E.S.B. 1961/56. Ten/17639)* 18th April. State Electricity Commission of Queensland. Steel cored aluminium conductors and accessories. (E.S.B. 2127/56. Ten/17657)*

Belfast.—24th February. City Electricity Department. Time switches, transformers, domestic equipment, etc. (See this issue.)

Bristol.—Southmead General Hospital Group Management Committee invites quotations for the supply of electric lamps from contractors not already on the Committee's list of suppliers. C. C. Hancocks, secretary, Administrative Offices, Southmead Hospital, Bristol.

Down.—16th February. County Education Committee. Electrical installation in Comber (New) Intermediate School. F. D. Brown & Sons, consulting engineers, 93, Ann Street, Belfast.

Egypt.—29th February. Government Peroleum Refinery, Suez. Lamp posts, cables and switchgear for the railway tank dispatch yard. (E.S.B. 2089/56. Ten/17666)*

Epsom and Ewell.—10th March. Corporation Water Department. Plant for East Street pumping station. (See this issue.)

Formosa.—29th February. Central Trust of China, Purchasing Department, Taipei. Equipment for a 3,000 kVA sub-station. (E.S.B. 2099/56/ICA. Ten/17686)*

Hawley.—25th February. Parish Council. Street lighting equipment. (See this issue.)

Hemel Hempstead. — 17th February. Borough Council. Supply of electric lamps (contract No. 23) for the year 1956-57. A. H. Turner, borough surveyor, High Street.

Ilford.—28th February. Borough Council. Installation of television aerials in blocks of flats. (See this issue.)

India.—15th February. Government of Travancore-Cochin. L.v. insulators and fittings. (E.S.B. 2392/56. Ten/17681)* 16th February. Government of Mysore. Cables, lightning arrestors, switches, etc. (E.S.B. 2300/56. Ten/17682)* 24th February. Director General of Supplies and Disposals, New Delhi. Transmitting, recording and measuring equipment. (E.S.B. 2003/56. Ten/17645)*

London.—2nd March. India Store Department. Installation kit, wireless remote control equipment, microphones, head sets, etc. (See this issue.)

Midlothian.—24th February. County Council. Street lighting equipment. (See this issue.)

Pontypridd.—20th February. U.D.C. Street lighting equipment. (See this issue.)

Tipperary (North Riding).—24th February. County Council. Electrical installation at new staff home, St. Mary's Hospital, Thurles. Sean Mulcahy, consulting engineer, 70, Merrion Square South, Dublin.

Tynemouth.—20th February. Borough Council. Supply of electric lamps and cable (schedule 13); lamp columns, lanterns and fittings (14); and housing electrical accessories (16), for the year ending 31st March, 1957. D. M. O'Herlihy, borough surveyor, 16, Northumberland Square, North Shields.

Widnes.—25th February. Borough Council. Supply of electrical equipment, lamps, etc., for the year ending 31st March 1957. (See this issue.)

ORDERS PLACED

Ashington (Northumberland). — U.D.C. Accepted. Electrical installations in 40 flats on the Beamsley Terrace site.—Bernard Berrie

Bromsgrove.—Birmingham Regional Hospital Board. Recommended. Electrical installation work at Barnsley Hall Hospital, Bromsgrove (£5,886).—B. French.

Essex.—County Council General Purposes Committee. Recommended. Telephone equipment for 50 extension lines at the County Hall, Chelmsford (£1,587).—Reliance Telephone Co.

Hull.—Corporation Telephone Committee. Recommended. Supply of 12¾ miles of lead-covered telephone cable (£8,231).—W. T. Glover & Co.

Newburn (Northumberland). — U.D.C. Electrical wiring of 88 houses on the Sugley Dene estate, Lemington.—J. B. Wilson (Whitley Bay).

Rushden.—U.D.C. Installation of street lighting in trunk road A.6 (£5,534).—North Midlands Engineering Co.

WORK IN PROSPECT

Particulars of new works and building schemes for the use of electrical installation contractors and traders. Publication in this section is no guarantee that electrical work is definitely included. Alleged inaccuracies should be reported to the Editors.

Beverley.—Bank and offices, Saturday Market; National Provincial Bank, Ltd., 15, Bishopsgate, London, E.C.2.

Biggleswade.—Houses (33); R.D.C. surveyor, Council Offices.

Billingham-on-Tees.—Presbyterian church and hall; S. W. Milburn and Partners, architects, 9, Esplanade, Sunderland.

Three nursery schools and a primary school; county architect, South Street, Durham.

Birkenhead.—Factory at Berner St, for R. McIvor & Sons, Ltd.; Wm. Thornton & Sons, Ltd, 38, Wellington Rd, Liverpool.

Birtley (Co. Durham). — Crematorium (£14,000); A. Ramage, contractor, 351, Old Durham Road, Gateshead.

Bolton.—St. Anne's R.C. Secondary School; Greenhalgh & Williams, architects, 15, Mawdsley Street.

Boston.—Three-storey secondary modern school at Stickney (£115,000); Lindsey county architect, County Offices, Newland, Lincoln.

Bournemouth.—Hotel, Poole Lane; Hall & Woodhouse, Ltd., The Brewery, Blandford Forum.

Conversions at hotel buildings, West Cliff, to form 41 flats; Jackson and Greenen, architects, Hinton Road.

Bradford.—Technical institute at Rose Mount, Manningham (£339,000); W. H. Leathem, town clerk, Town Hall.

Brimsdown.—Works extensions; Ruberoid Co., Ltd., Stockingswater Lane.

Bristol.—Fifteen-storey offices at Barton Hall; city architect, Eagle House, Colston Avenue, 1.

Brixworth.—Houses (50); R.D.C. surveyor, Council Offices, Brixworth, Northants.

Burnley.—Rebuilding factory premises; T. Haythornthwaite, Ltd., garment manufacturers, Tunstill Street.

Carlisle.—Office block, Harraby industrial estate, for the Automatic Coal Cleaning Co., Ltd.; John Laing and Sons, builders, Dalston Road, Carlisle.

Chesterfield.—Houses (63), Whitecotes Farm site, Boythorpe; borough architect.

Cumberland.—Library at Flatts Walk, Whitehaven; county architect, Portland Square, Carlisle.

Doncaster.—Secondary modern school (£154,000); borough architect.

Dorchester.—Flats (73), Mill Street area redevelopment; borough surveyor, Guildhall Chambers.

Durham.—Infants' school at Trimdon Village (£25,000); G. M. Pearson and Son, builders, Front Street, Hetton.

Hornsey.—Offices in Tottenham Lane (£115,000); Huckle and Durkin, architects, Queen Anne Street, London, W.1.

Hove.—Clothing factory in Brunswick Street (£45,000); C. Kulawy, 1, Upper St. James Street, Brighton, 7.

Ilford.—Five-storey laboratory block; Ilford, Ltd., Roden Street.

Ilfracombe.—Modernization of Alexandra Theatre; clerk, U.D.C. Offices.

Manchester.—Printing works, Lomax Street, Ancoats; Tom Haigh & Co., Ltd., printers, 178, Great Ancoats Street, Ardwick, 4.

Newport (I.o.W.).—Extensions to factory; Hibberd Gould & Randall, Ltd., mineral water manufacturers, Church Litten.

Northumberland.—Additions to Alnwick Modern School; county architect, County Hall, Newcastle-on-Tyne.

Norwich.—Blocks of eight-storey offices, Surrey Street/Westergate; T. P. Bennett & Son, architects, 43, Bloomsbury Square, London, W.C.1.

Smethwick.—Dwellings (650), redevelopment site No. 2; Geo. Wimpey & Co., Ltd., Chester Road, Castle Bromwich.

South Shields.—Additions to the Town Hall (£90,000); John Reid, borough engineer.

Southend-on-Sea.—Eight-storey building at Victoria Avenue; Ministry of Works, Abell House, John Islip Street, London, S.W.1.

Stanley.—Factory, Blooms Ground, for W. Pinkham & Sons, glove manufacturers, Park Road; Marshall & Tweedy, architects, Blackett Street, Newcastle-on-Tyne.

Stockton-on-Tees.—Secondary school at Roseworth; borough architect, 28, The Square.

Outpatients' department at Stockton Children's Hospital; P. H. Knighton, chief architect, Newcastle Hospital Board, Benfield Road, Newcastle-on-Tyne.

Rebuilding warehouse on the Corporation Quay (£62,000); borough engineer, Victoria Buildings.

Surbiton.—Factory, Red Lion Road; E. Hill Adlam & Co., Ltd., sliding door makers, Haslemere Avenue, Wimbledon, S.W.18.

Wakefield.—Factory in Low Lane, Durkar; Raybrook Precision Engineering Co., Ltd., 497, Denby Dale Road, Calder Grove, Horbury.

Wembley.—Factory and laboratory; G. & E. Bradley, Ltd., Beresford House, Mount Pleasant.

St. Joseph's Church, High Road; Reynolds & Scott, architects, 9, Albert Square, Manchester.

Worcestershire.—Day special school in Feldon Lane and primary school in Howle Grange Road, Halesowen; extensions to Redditch Bridley Moor County Secondary School ambulance station and houses at Red Hill Stourbridge; L. C. Lomas, county architect 14, Castle Street, Worcester.

* Specifications may be inspected at the Export Services Branch, Board of Trade, Lacon House, Theobald's Road, London, W.C.1 (Chancery 4411; extension 769).